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(54) PATIENT CARE DELIVERY SYSTEM

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Publication Classification

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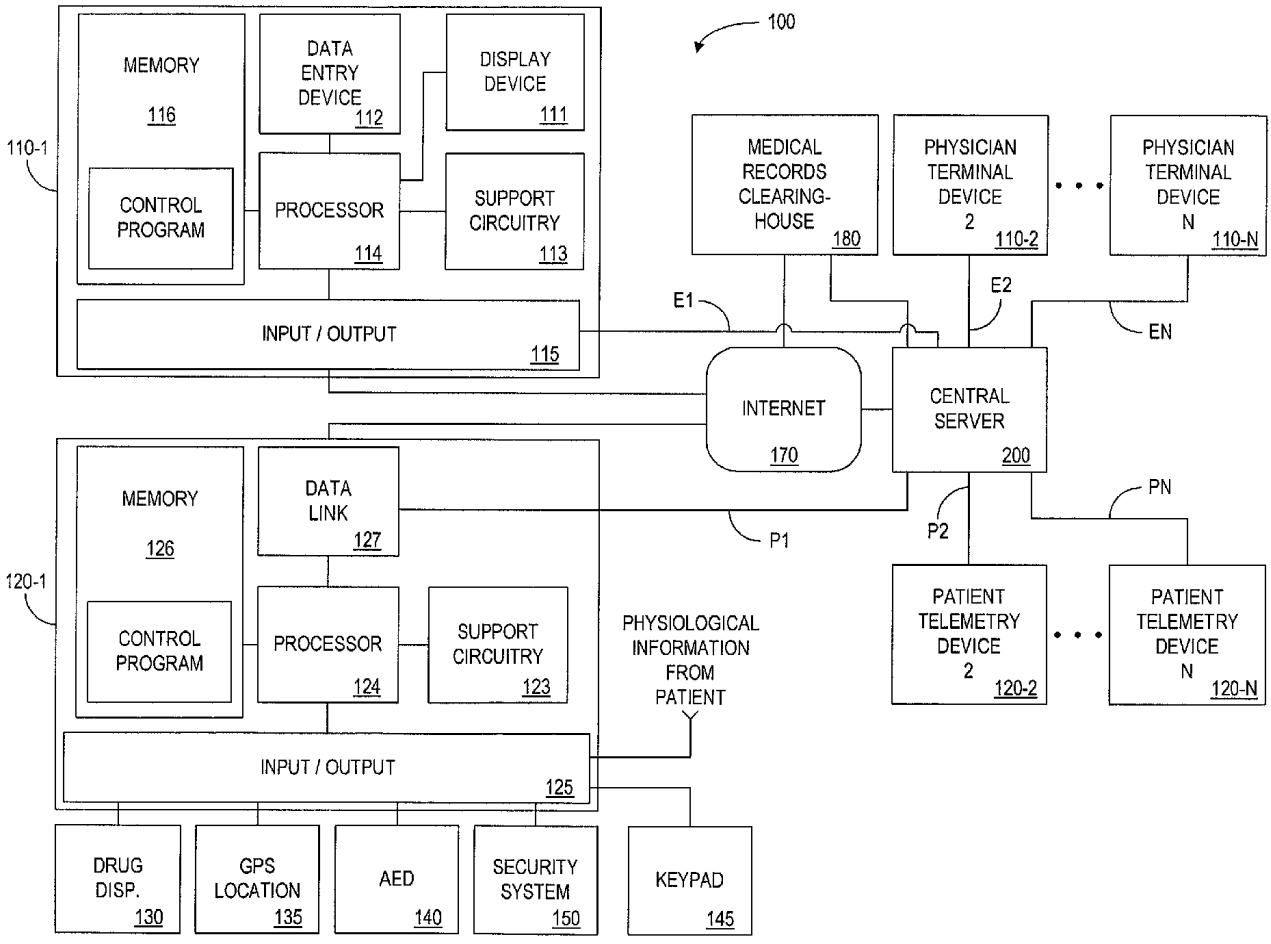
(52) **U.S. Cl.** **600/300**

(57) ABSTRACT

A method and apparatus for analyzing data from remote monitoring equipment, such as patient telemetry devices, and determining (i) whether an anomalous event has occurred, (ii) if an anomalous event has occurred, whether a physician should be contacted, and (iii) if a physician should be contacted, selecting the physician to contact. Further, the system operates in parallel, in that a plurality of experts (e.g. physicians) may be contacted in response to a single or multiple anomalous events, thus ensuring an efficient response to an anomalous event.



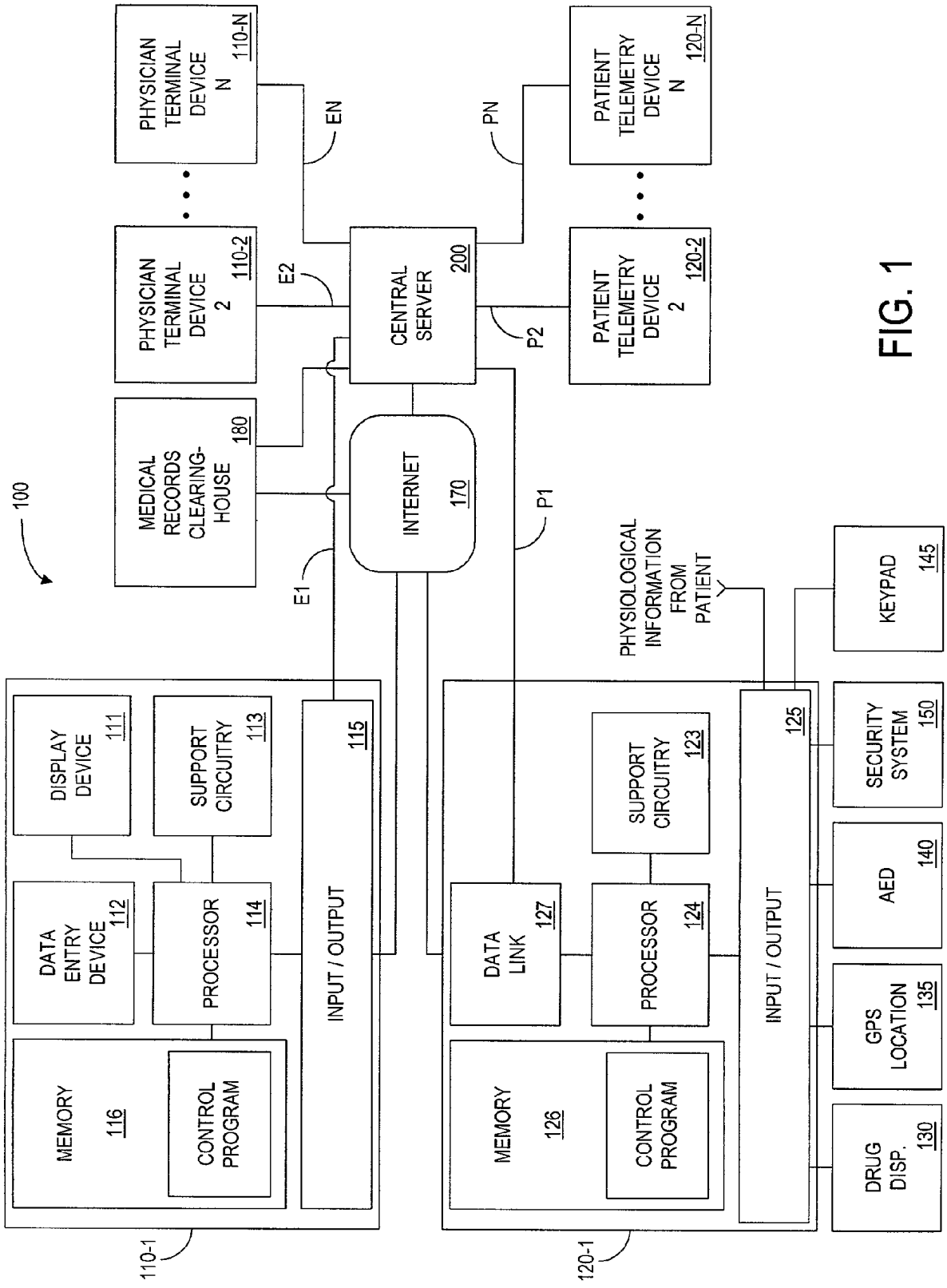

100
PHYSICIAN TERMINAL DEVICE N 110-N
PHYSICIAN TERMINAL DEVICE 2 110-2
MEDICAL RECORDS CLEARING-HOUSE 180
CENTRAL SERVER 200
INTERNET 170
PATIENT TELEMETRY DEVICE N 120-N
PATIENT TELEMETRY DEVICE 2 120-2
EN
E2
E1
PN
P2
P1
PHYSIOLOGICAL INFORMATION FROM PATIENT
DISPLAY DEVICE 111
DATA ENTRY DEVICE 112
SUPPORT CIRCUITRY 113
PROCESSOR 114
INPUT / OUTPUT 115
MEMORY 116
CONTROL PROGRAM
110-1
DATA LINK 127
SUPPORT CIRCUITRY 123
PROCESSOR 124
INPUT / OUTPUT 125
MEMORY 126
CONTROL PROGRAM
120-1
KEYPAD 145
SECURITY SYSTEM 150
AED 140
GPS LOCATION 135
DRUG DISP. 130

FIG. 1

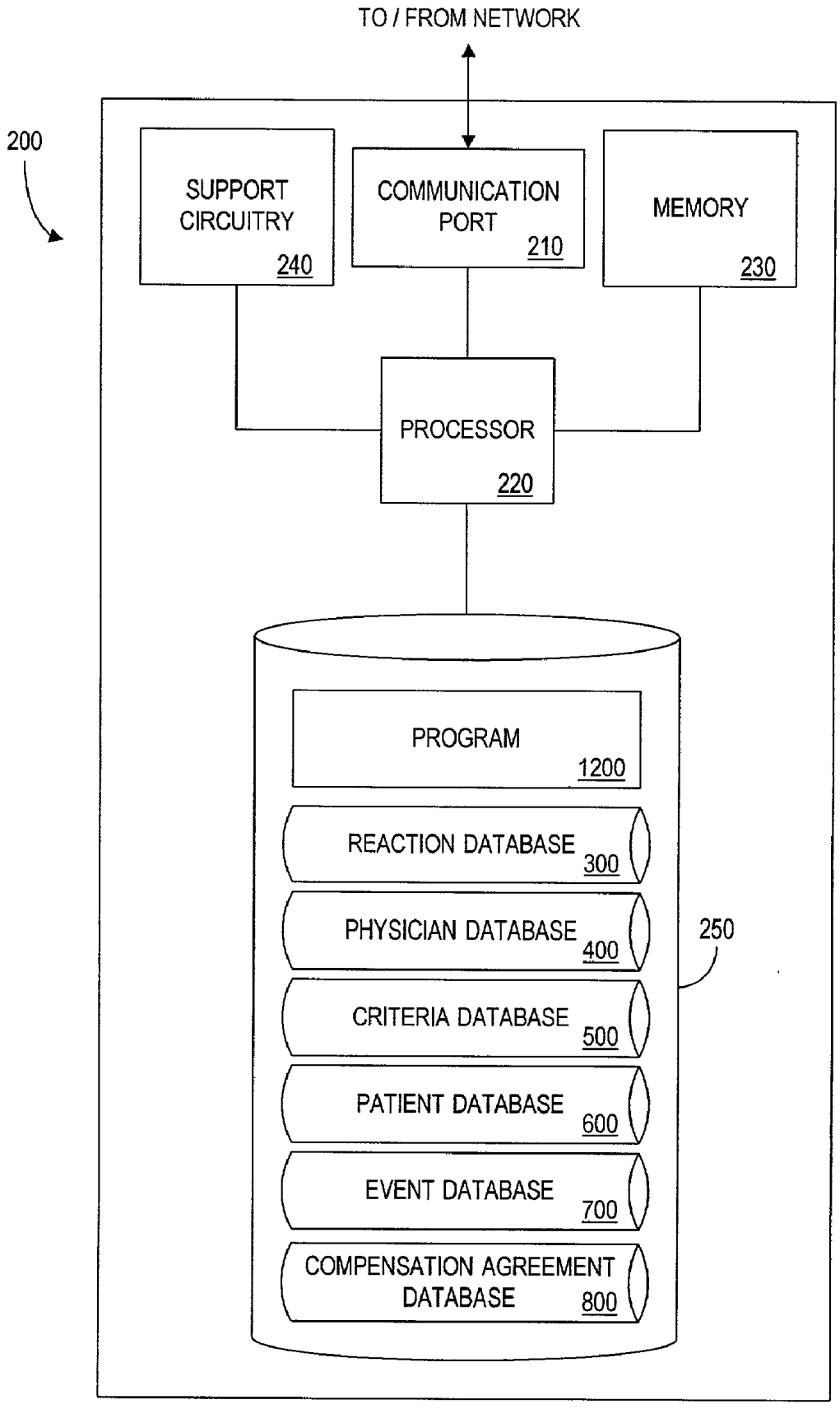
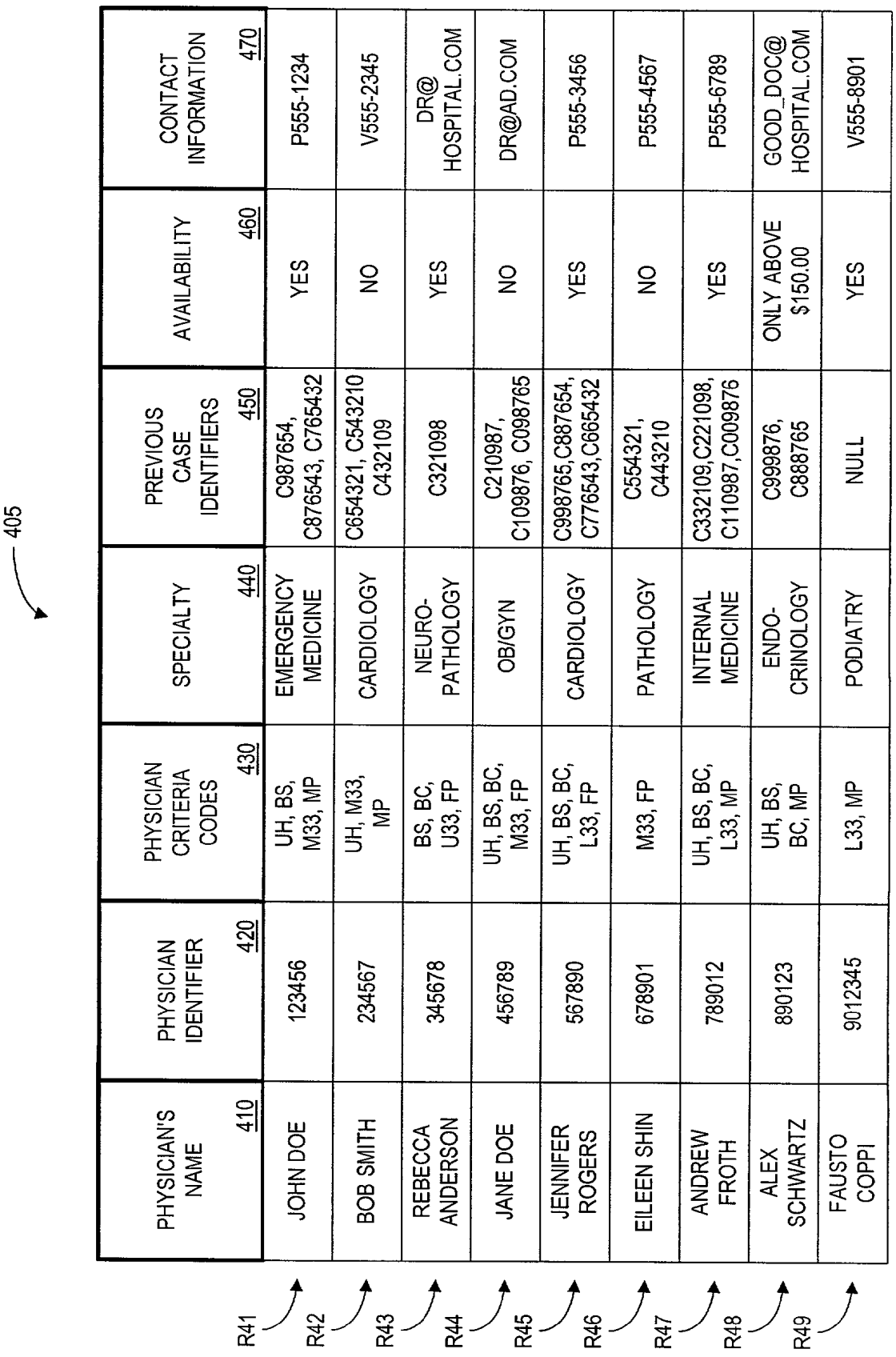

TO / FROM NETWORK
200
SUPPORT CIRCUITRY 240
COMMUNICATION PORT 210
MEMORY 230
PROCESSOR 220
PROGRAM 1200
REACTION DATABASE 300
PHYSICIAN DATABASE 400
CRITERIA DATABASE 500
PATIENT DATABASE 600
EVENT DATABASE 700
COMPENSATION AGREEMENT DATABASE 800
250

FIG. 2

	ALERT 310	SYSTEM REACTION 320
R31	VENTRICULAR FIBRILLATION	SUMMON AMBULANCE; OFFER CASE TO CARDIOLOGIST(S)
R32	LOSS OF CONSCIOUSNESS	SUMMON AMBULANCE; OFFER CASE TO ER PHYSICIAN(S)
R33	ABERRANT BLOOD GLUCOSE LEVELS	INSTRUCT PATIENT TO TAKE INSULIN; IF LEVELS DO NOT RETURN TO NORMAL AFTER 15 MINUTES, OFFER CASE TO NURSE(S)
R34	FETAL HEART MONITOR ALARM	ALERT MOTHER; INSTRUCT HER TO GO TO HOSPITAL; OFFER CASE TO OBSTETRICIAN(S)
R35	TACHYCARDIA	OFFER CASE TO CARDIOLOGIST(S); QUERY PATIENT AS TO ACTIVITY LEVEL
R36	ACUTELY HIGH BLOOD PRESSURE	OFFER CASE TO INTERNIST(S);QUERY PATIENT AS TO ACTIVITY LEVEL

FIG. 3



PHYSICIAN'S NAME 410	PHYSICIAN IDENTIFIER 420	PHYSICIAN CRITERIA CODES 430	SPECIALTY 440	PREVIOUS CASE IDENTIFIERS 450	AVAILABILITY 460	CONTACT INFORMATION 470
JOHN DOE	123456	UH, BS, M33, MP	EMERGENCY MEDICINE	C987654, C876543, C765432	YES	P555-1234
BOB SMITH	234567	UH, M33, MP	CARDIOLOGY	C654321, C543210 C432109	NO	V555-2345
REBECCA ANDERSON	345678	BS, BC, U33, FP	NEURO-PATHOLOGY	C321098	YES	DR@ HOSPITAL.COM
JANE DOE	456789	UH, BS, BC, M33, FP	OB/GYN	C210987, C109876, C098765	NO	DR@AD.COM
JENNIFER ROGERS	567890	UH, BS, BC, L33, FP	CARDIOLOGY	C998765,C887654, C776543,C665432	YES	P555-3456
EILEEN SHIN	678901	M33, FP	PATHOLOGY	C554321, C443210	NO	P555-4567
ANDREW FROTH	789012	UH, BS, BC, L33, MP	INTERNAL MEDICINE	C332109,C221098, C110987,C009876	YES	P555-6789
ALEX SCHWARTZ	890123	UH, BS, BC, MP	ENDO-CRINOLOGY	C999876, C888765	ONLY ABOVE $150.00	GOOD_DOC@ HOSPITAL.COM
FAUSTO COPPI	9012345	L33, MP	PODIATRY	NULL	YES	V555-8901

FIG. 4

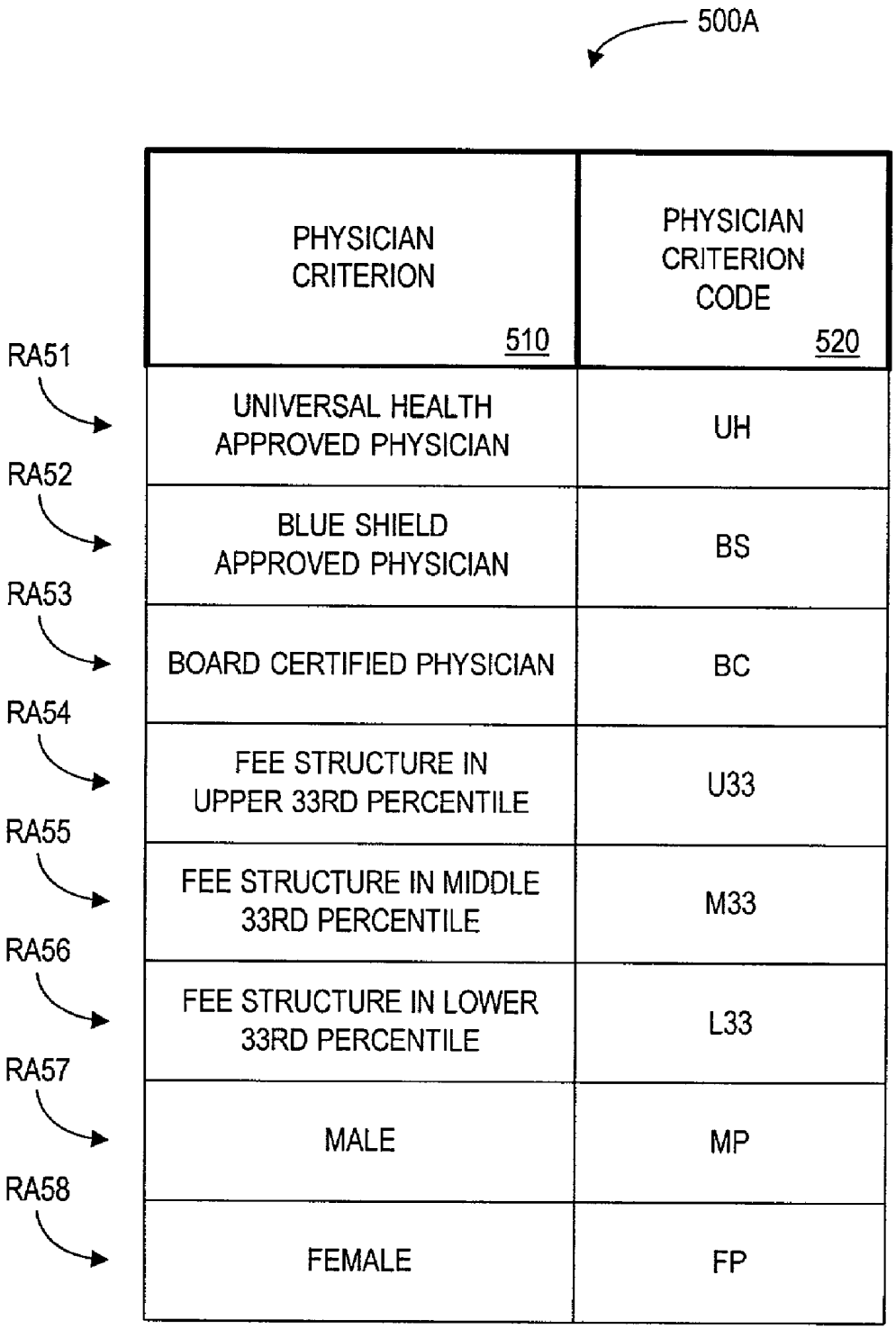

500A
PHYSICIAN CRITERION 510
PHYSICIAN CRITERION CODE 520
RA51
UNIVERSAL HEALTH APPROVED PHYSICIAN
UH
RA52
BLUE SHIELD APPROVED PHYSICIAN
BS
RA53
BOARD CERTIFIED PHYSICIAN
BC
RA54
FEE STRUCTURE IN UPPER 33RD PERCENTILE
U33
RA55
FEE STRUCTURE IN MIDDLE 33RD PERCENTILE
M33
RA56
FEE STRUCTURE IN LOWER 33RD PERCENTILE
L33
RA57
MALE
MP
RA58
FEMALE
FP

FIG. 5A

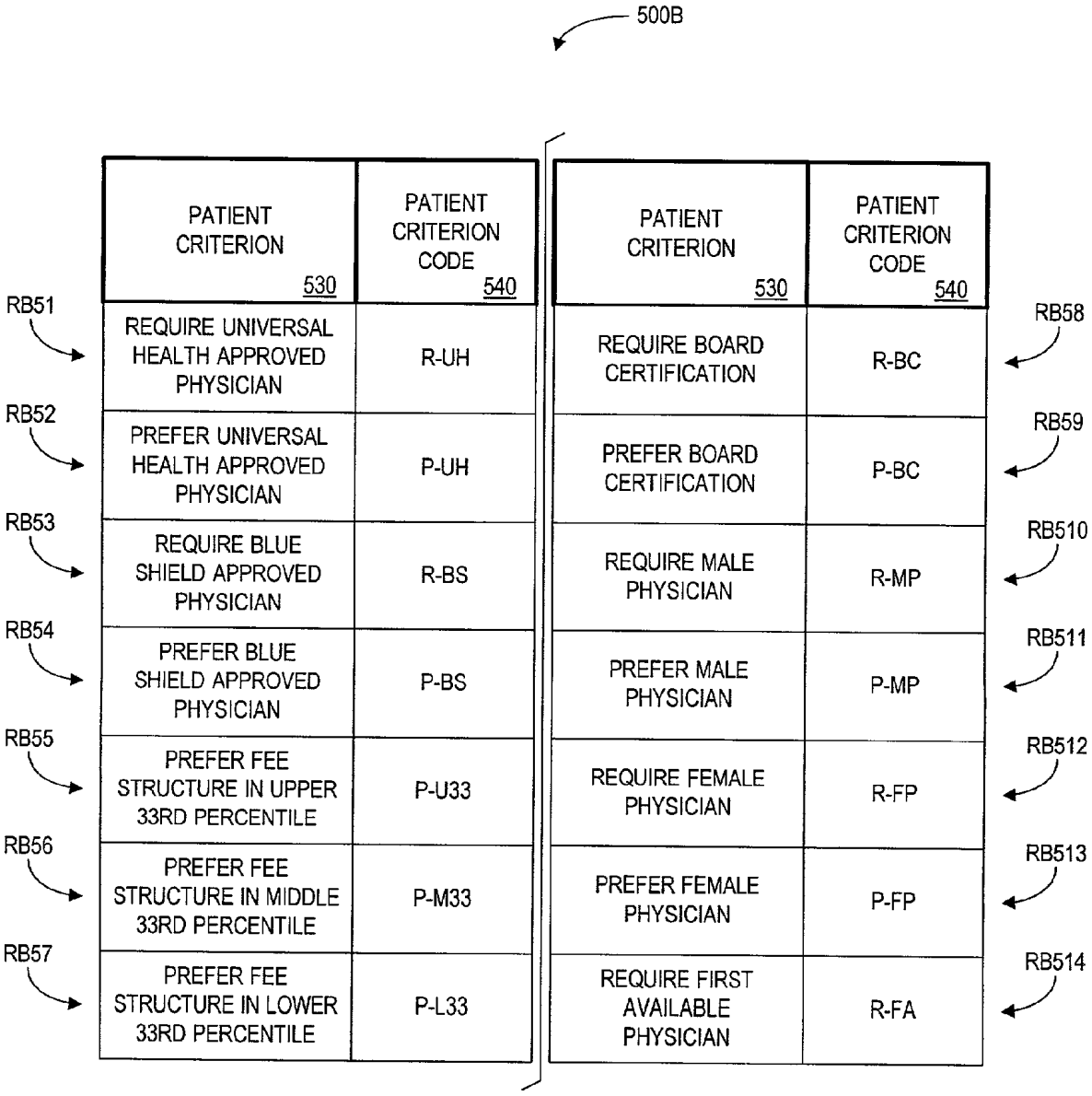

500B
PATIENT CRITERION 530
PATIENT CRITERION CODE 540
RB51
REQUIRE UNIVERSAL HEALTH APPROVED PHYSICIAN
R-UH
RB52
PREFER UNIVERSAL HEALTH APPROVED PHYSICIAN
P-UH
RB53
REQUIRE BLUE SHIELD APPROVED PHYSICIAN
R-BS
RB54
PREFER BLUE SHIELD APPROVED PHYSICIAN
P-BS
RB55
PREFER FEE STRUCTURE IN UPPER 33RD PERCENTILE
P-U33
RB56
PREFER FEE STRUCTURE IN MIDDLE 33RD PERCENTILE
P-M33
RB57
PREFER FEE STRUCTURE IN LOWER 33RD PERCENTILE
P-L33
PATIENT CRITERION 530
PATIENT CRITERION CODE 540
RB58
REQUIRE BOARD CERTIFICATION
R-BC
RB59
PREFER BOARD CERTIFICATION
P-BC
RB510
REQUIRE MALE PHYSICIAN
R-MP
RB511
PREFER MALE PHYSICIAN
P-MP
RB512
REQUIRE FEMALE PHYSICIAN
R-FP
RB513
PREFER FEMALE PHYSICIAN
P-FP
RB514
REQUIRE FIRST AVAILABLE PHYSICIAN
R-FA

FIG. 5B

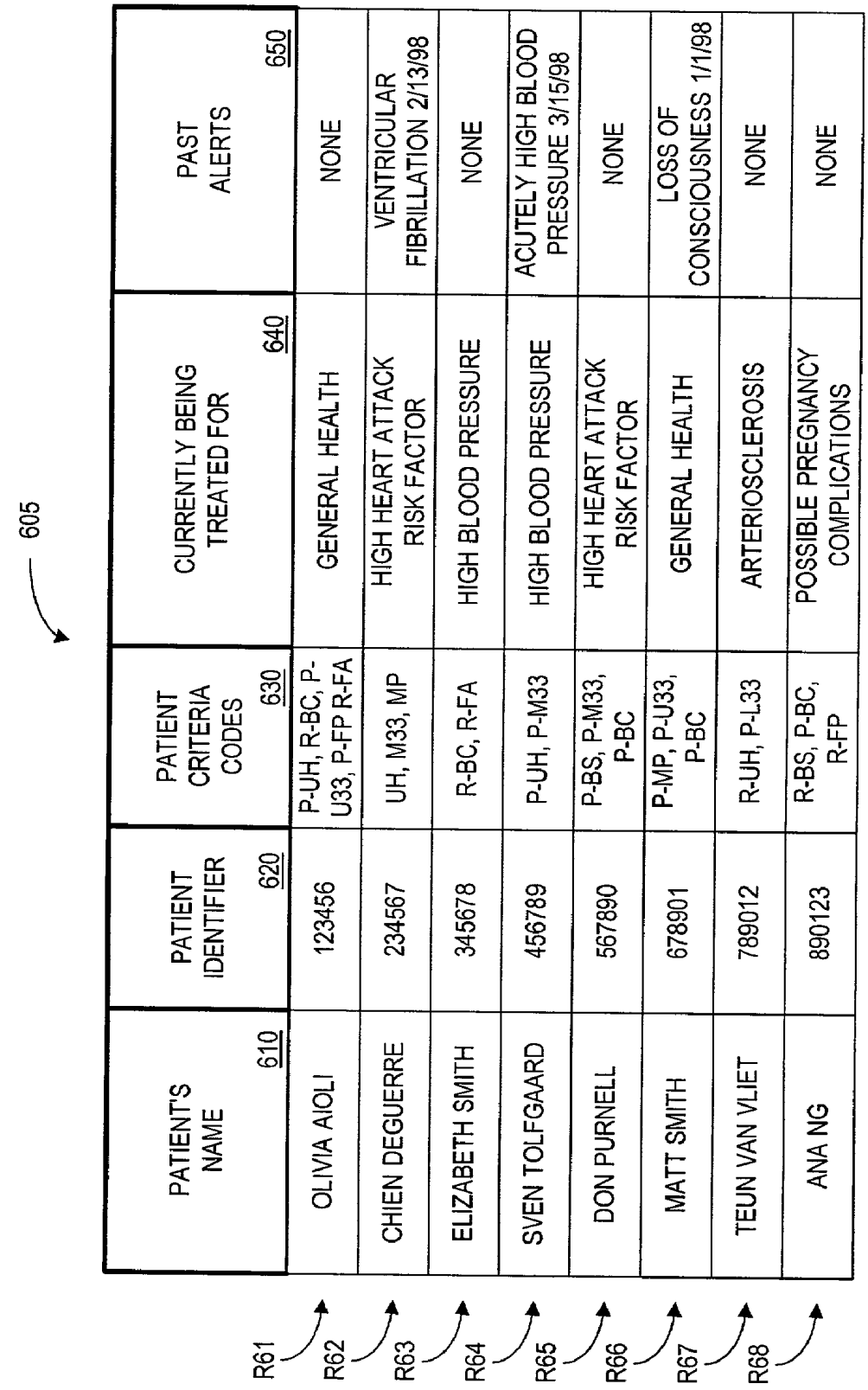

605
PATIENT'S NAME 610
PATIENT IDENTIFIER 620
PATIENT CRITERIA CODES 630
CURRENTLY BEING TREATED FOR 640
PAST ALERTS 650
R61
OLIVIA AIOLI
123456
P-UH, R-BC, P-U33, P-FP R-FA
GENERAL HEALTH
NONE
R62
CHIEN DEGUERRE
234567
UH, M33, MP
HIGH HEART ATTACK RISK FACTOR
VENTRICULAR FIBRILLATION 2/13/98
R63
ELIZABETH SMITH
345678
R-BC, R-FA
HIGH BLOOD PRESSURE
NONE
R64
SVEN TOLFGAARD
456789
P-UH, P-M33
HIGH BLOOD PRESSURE
ACUTELY HIGH BLOOD PRESSURE 3/15/98
R65
DON PURNELL
567890
P-BS, P-M33, P-BC
HIGH HEART ATTACK RISK FACTOR
NONE
R66
MATT SMITH
678901
P-MP, P-U33, P-BC
GENERAL HEALTH
LOSS OF CONSCIOUSNESS 1/1/98
R67
TEUN VAN VLIET
789012
R-UH, P-L33
ARTERIOSCLEROSIS
NONE
R68
ANA NG
890123
R-BS, P-BC, R-FP
POSSIBLE PREGNANCY COMPLICATIONS
NONE

FIG. 6

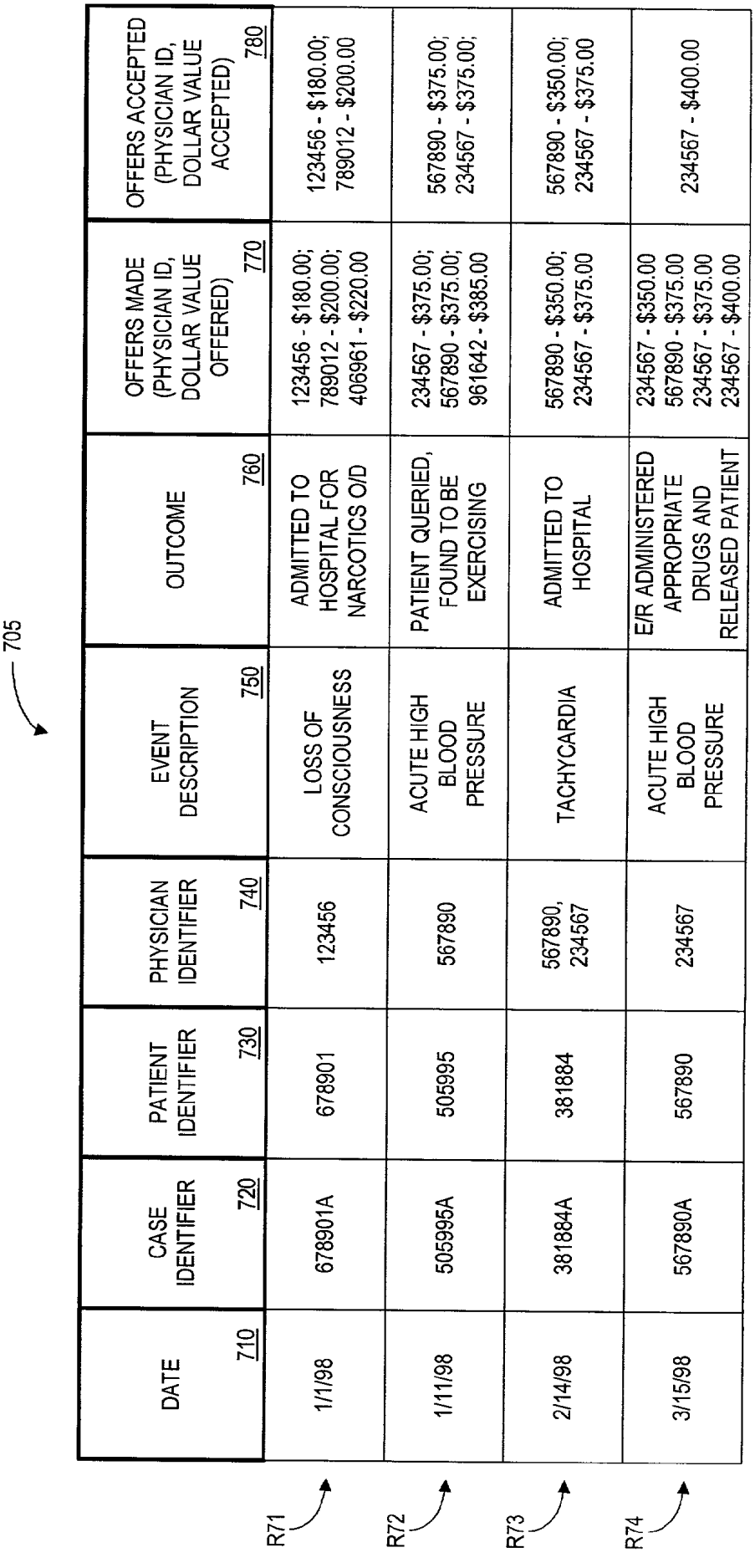

705
DATE 710
CASE IDENTIFIER 720
PATIENT IDENTIFIER 730
PHYSICIAN IDENTIFIER 740
EVENT DESCRIPTION 750
OUTCOME 760
OFFERS MADE (PHYSICIAN ID, DOLLAR VALUE OFFERED) 770
OFFERS ACCEPTED (PHYSICIAN ID, DOLLAR VALUE ACCEPTED) 780
R71
1/1/98
678901A
678901
123456
LOSS OF CONSCIOUSNESS
ADMITTED TO HOSPITAL FOR NARCOTICS O/D
123456 - $180.00; 789012 - $200.00; 406961 - $220.00
123456 - $180.00; 789012 - $200.00
R72
1/11/98
505995A
505995
567890
ACUTE HIGH BLOOD PRESSURE
PATIENT QUERIED, FOUND TO BE EXERCISING
234567 - $375.00; 567890 - $375.00; 961642 - $385.00
567890 - $375.00; 234567 - $375.00;
R73
2/14/98
381884A
381884
567890, 234567
TACHYCARDIA
ADMITTED TO HOSPITAL
567890 - $350.00; 234567 - $375.00
567890 - $350.00; 234567 - $375.00
R74
3/15/98
567890A
567890
234567
ACUTE HIGH BLOOD PRESSURE
E/R ADMINISTERED APPROPRIATE DRUGS AND RELEASED PATIENT
234567 - $350.00 567890 - $375.00 234567 - $375.00 234567 - $400.00
234567 - $400.00

FIG. 7

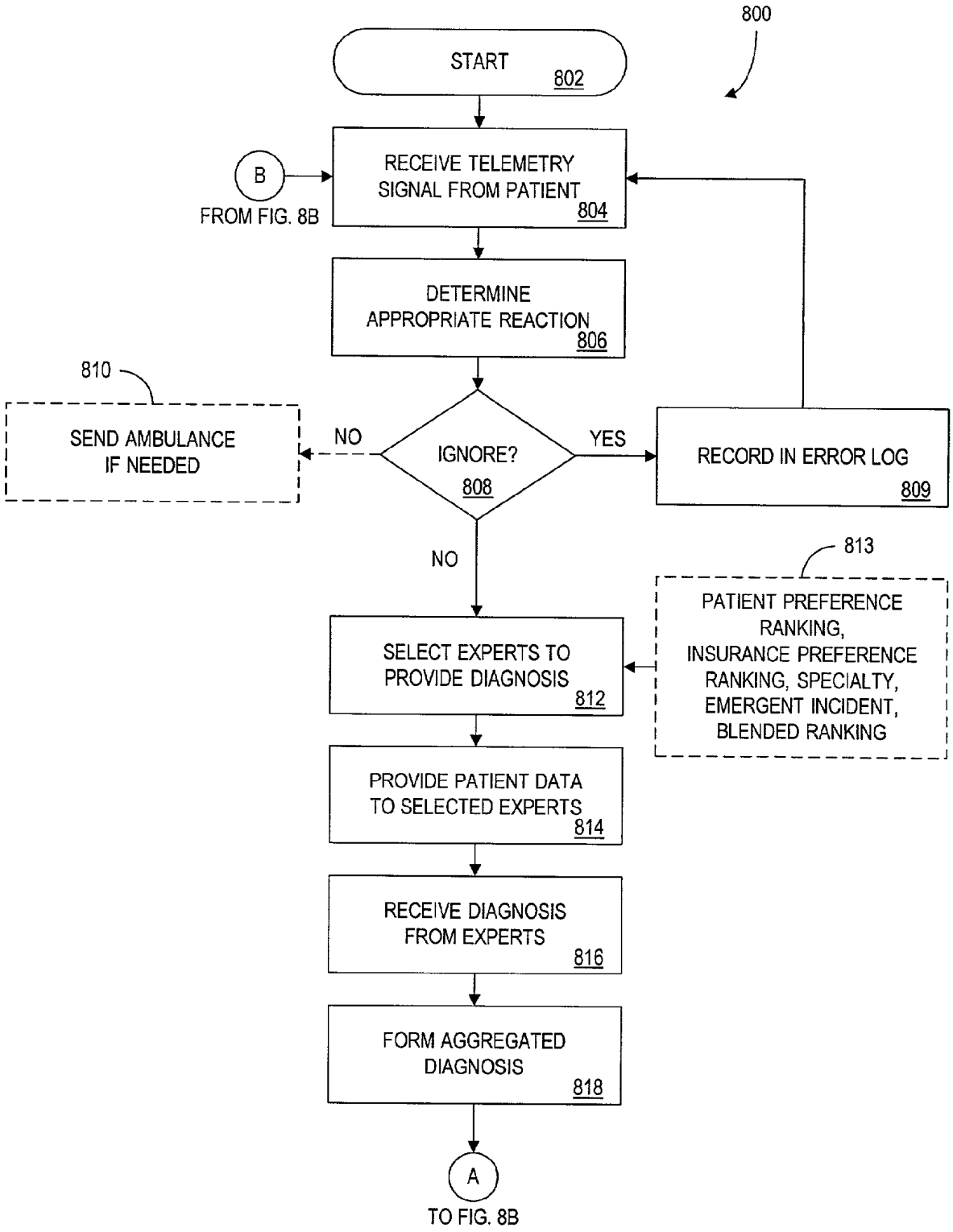

800
START
802
B
FROM FIG. 8B
RECEIVE TELEMETRY SIGNAL FROM PATIENT
804
DETERMINE APPROPRIATE REACTION
806
810
SEND AMBULANCE IF NEEDED
NO
IGNORE?
808
YES
RECORD IN ERROR LOG
809
NO
813
PATIENT PREFERENCE RANKING, INSURANCE PREFERENCE RANKING, SPECIALTY, EMERGENT INCIDENT, BLENDED RANKING
SELECT EXPERTS TO PROVIDE DIAGNOSIS
812
PROVIDE PATIENT DATA TO SELECTED EXPERTS
814
RECEIVE DIAGNOSIS FROM EXPERTS
816
FORM AGGREGATED DIAGNOSIS
818
A
TO FIG. 8B

FIG. 8A

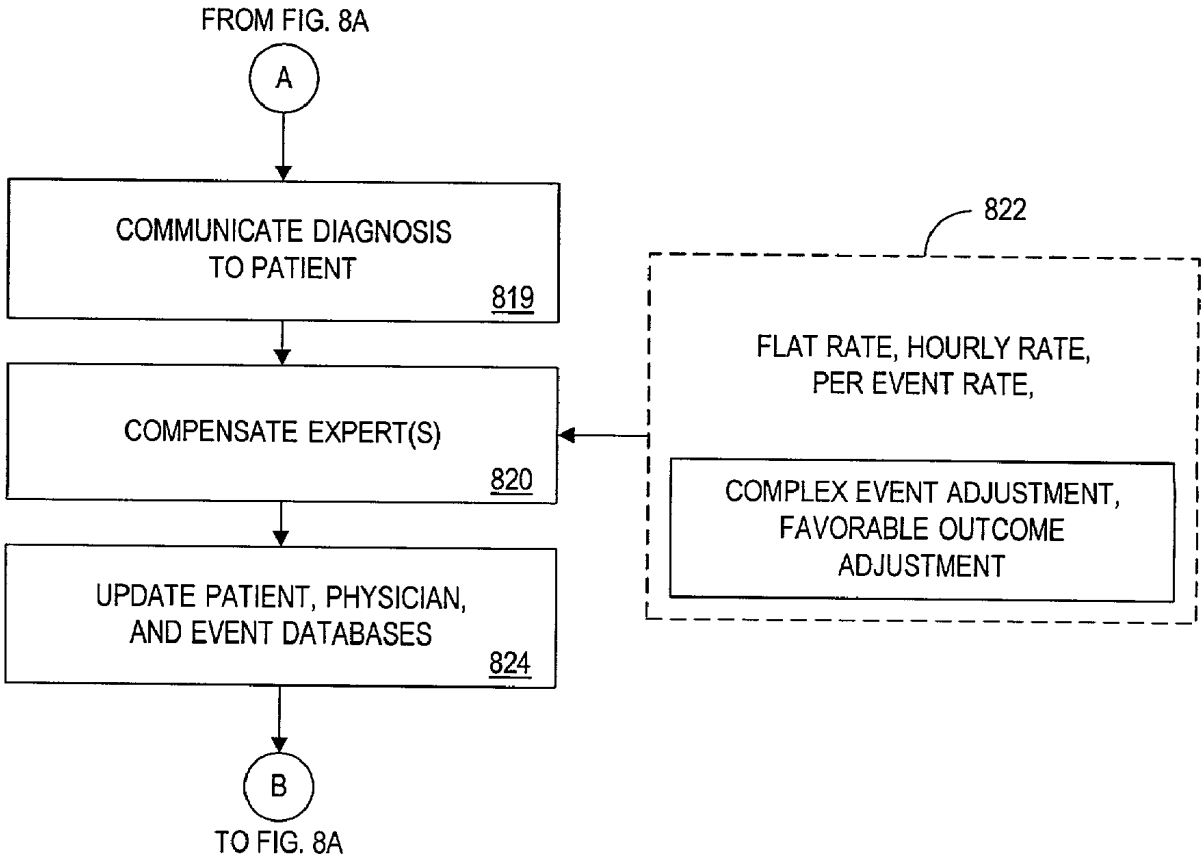

FROM FIG. 8A
A
COMMUNICATE DIAGNOSIS TO PATIENT
819
COMPENSATE EXPERT(S)
820
UPDATE PATIENT, PHYSICIAN, AND EVENT DATABASES
824
B
TO FIG. 8A
822
FLAT RATE, HOURLY RATE, PER EVENT RATE,
COMPLEX EVENT ADJUSTMENT, FAVORABLE OUTCOME ADJUSTMENT

FIG. 8B

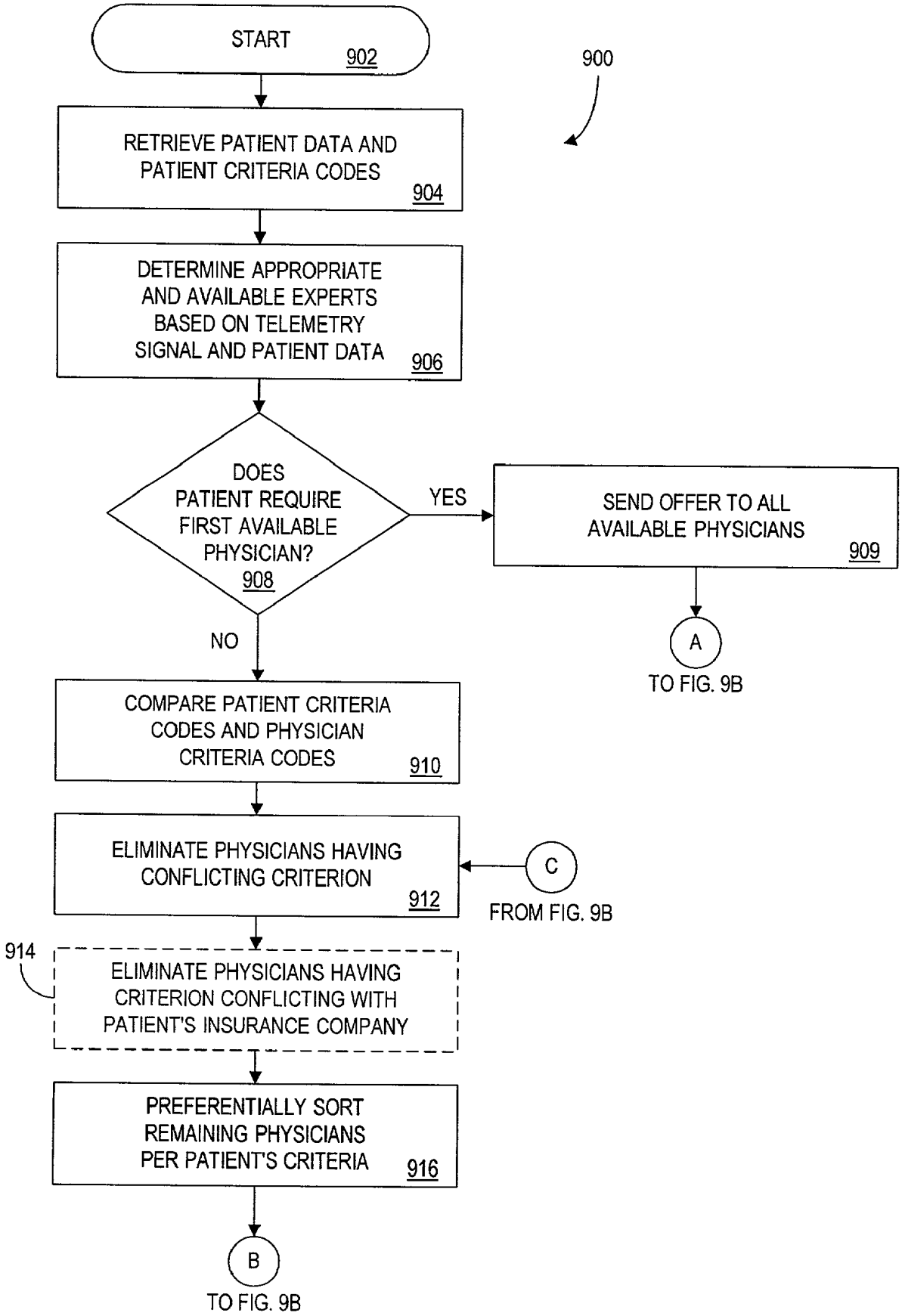

START
902
900
RETRIEVE PATIENT DATA AND PATIENT CRITERIA CODES
904
DETERMINE APPROPRIATE AND AVAILABLE EXPERTS BASED ON TELEMETRY SIGNAL AND PATIENT DATA
906
DOES PATIENT REQUIRE FIRST AVAILABLE PHYSICIAN?
908
YES
SEND OFFER TO ALL AVAILABLE PHYSICIANS
909
A
TO FIG. 9B
NO
COMPARE PATIENT CRITERIA CODES AND PHYSICIAN CRITERIA CODES
910
ELIMINATE PHYSICIANS HAVING CONFLICTING CRITERION
912
C
FROM FIG. 9B
914
ELIMINATE PHYSICIANS HAVING CRITERION CONFLICTING WITH PATIENT'S INSURANCE COMPANY
PREFERENTIALLY SORT REMAINING PHYSICIANS PER PATIENT'S CRITERIA
916
B
TO FIG. 9B

FIG. 9A

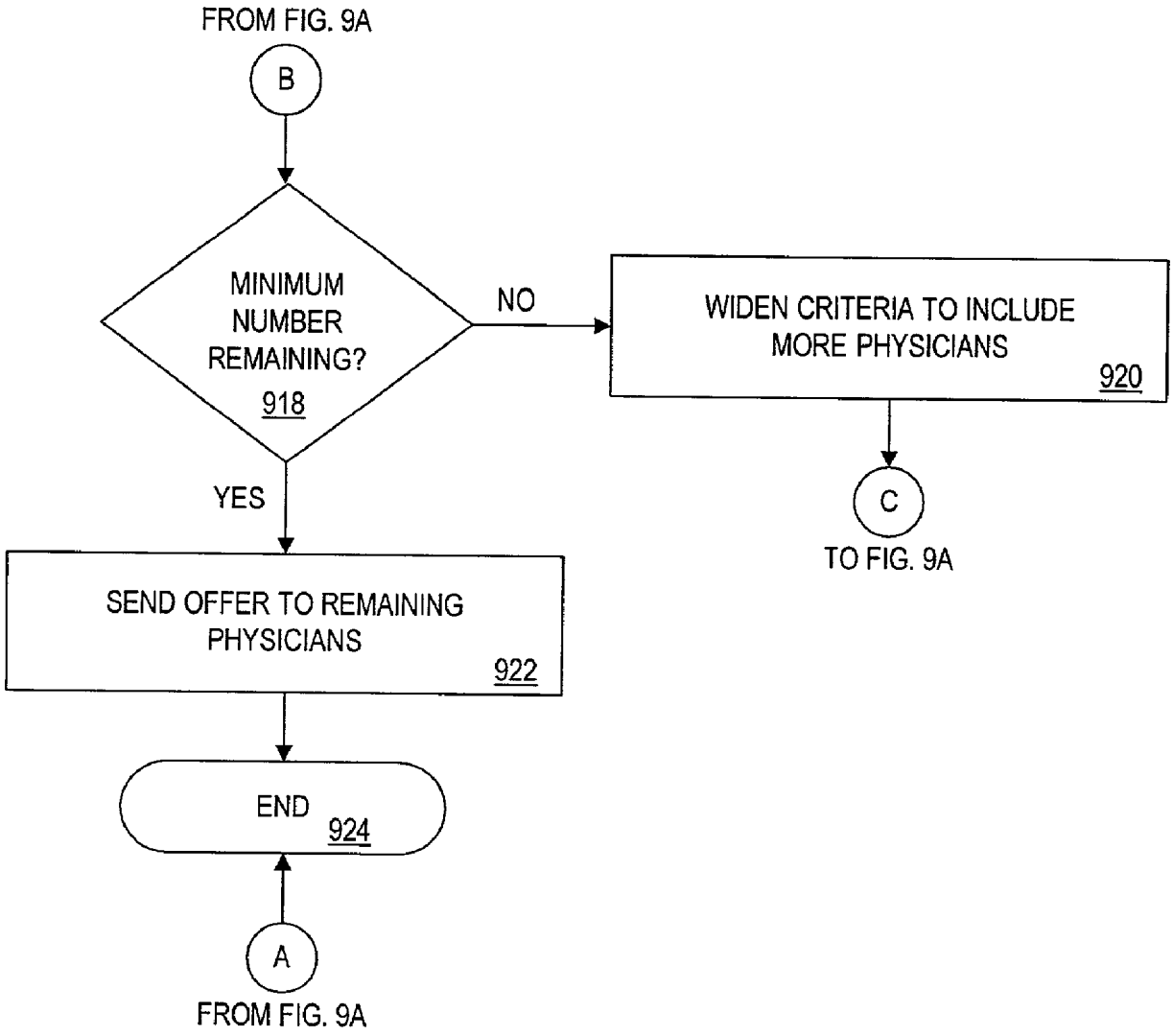

FROM FIG. 9A
B
MINIMUM NUMBER REMAINING?
918
NO
WIDEN CRITERIA TO INCLUDE MORE PHYSICIANS
920
C
TO FIG. 9A
YES
SEND OFFER TO REMAINING PHYSICIANS
922
END
924
A
FROM FIG. 9A

FIG. 9B

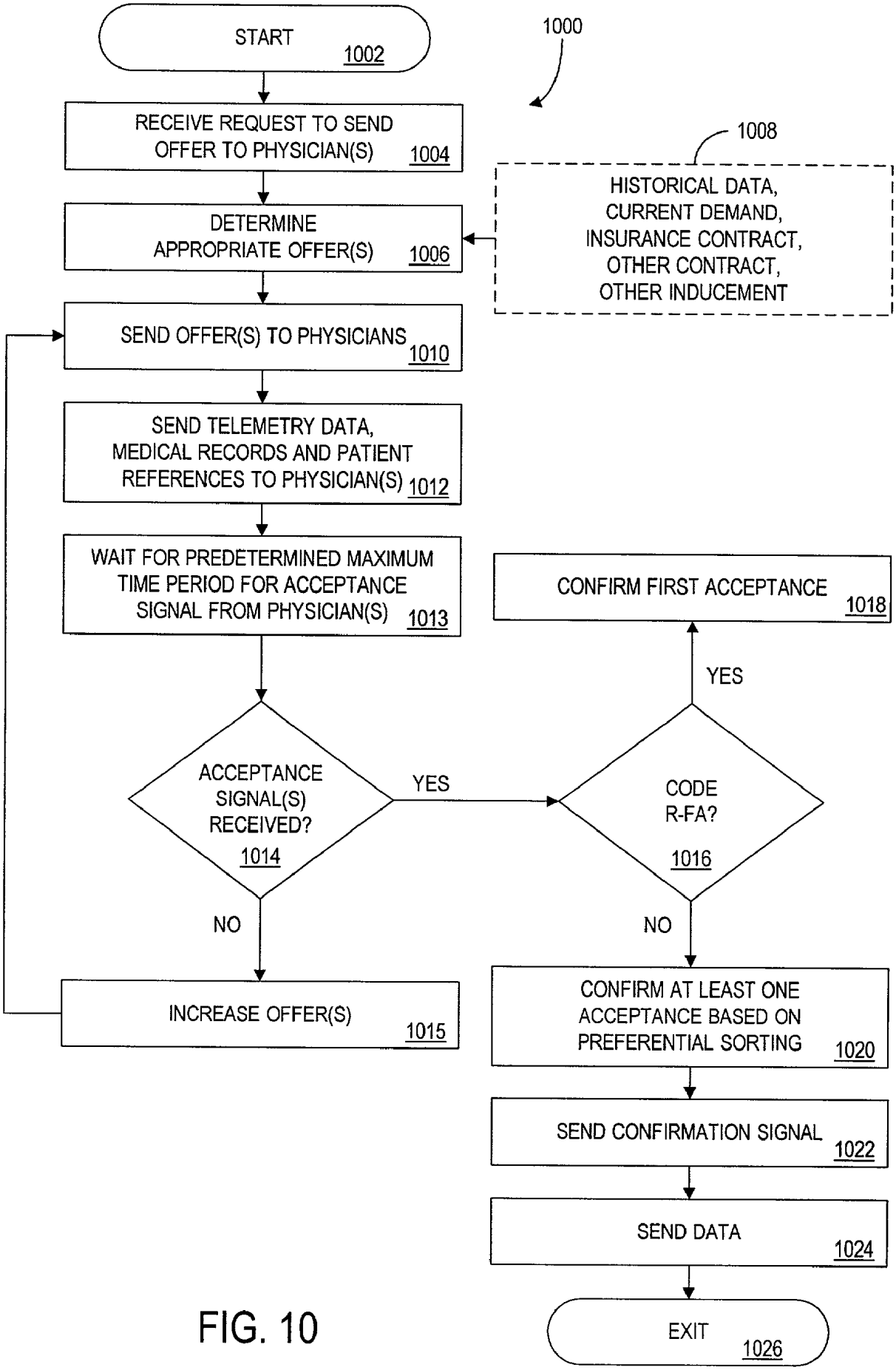

START
1002
1000
RECEIVE REQUEST TO SEND OFFER TO PHYSICIAN(S)
1004
1008
HISTORICAL DATA, CURRENT DEMAND, INSURANCE CONTRACT, OTHER CONTRACT, OTHER INDUCEMENT
DETERMINE APPROPRIATE OFFER(S)
1006
SEND OFFER(S) TO PHYSICIANS
1010
SEND TELEMETRY DATA, MEDICAL RECORDS AND PATIENT REFERENCES TO PHYSICIAN(S)
1012
WAIT FOR PREDETERMINED MAXIMUM TIME PERIOD FOR ACCEPTANCE SIGNAL FROM PHYSICIAN(S)
1013
CONFIRM FIRST ACCEPTANCE
1018
YES
ACCEPTANCE SIGNAL(S) RECEIVED?
1014
YES
CODE R-FA?
1016
NO
NO
INCREASE OFFER(S)
1015
CONFIRM AT LEAST ONE ACCEPTANCE BASED ON PREFERENTIAL SORTING
1020
SEND CONFIRMATION SIGNAL
1022
SEND DATA
1024
EXIT
1026

FIG. 10

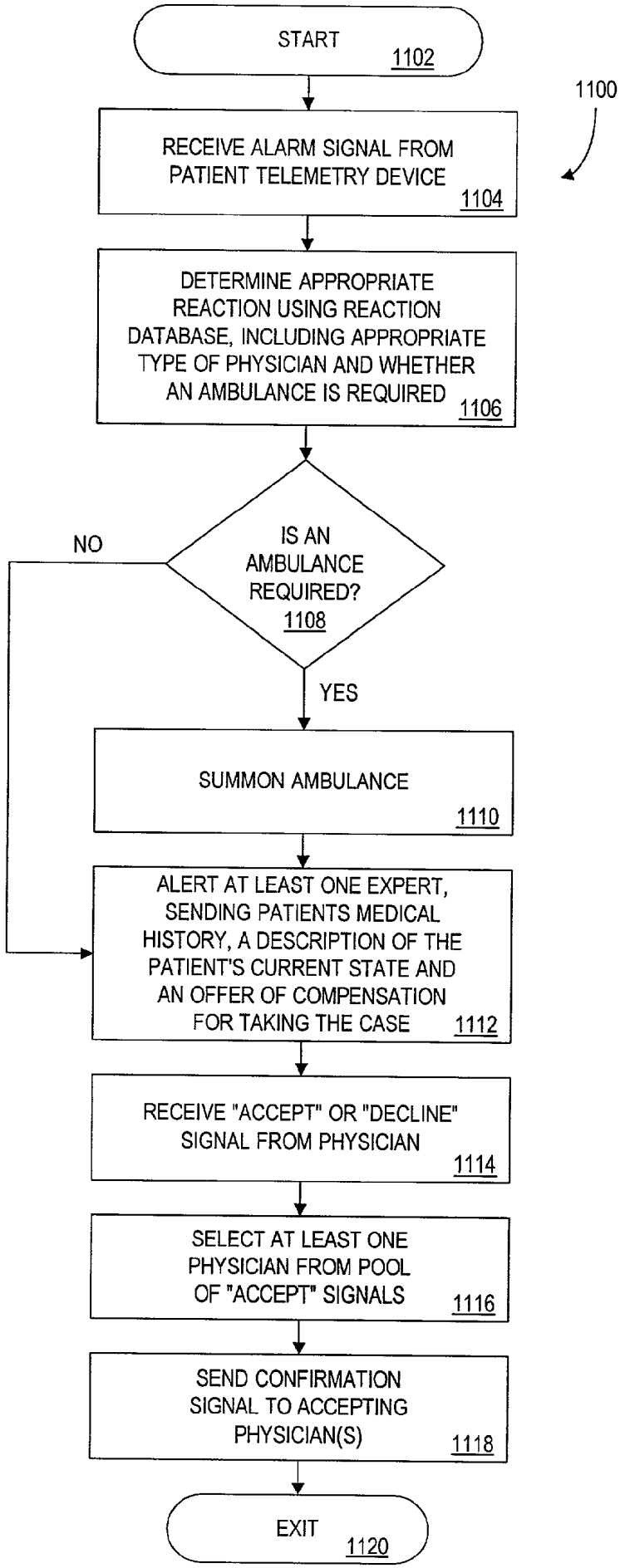

START
1102
1100
RECEIVE ALARM SIGNAL FROM PATIENT TELEMETRY DEVICE
1104
DETERMINE APPROPRIATE REACTION USING REACTION DATABASE, INCLUDING APPROPRIATE TYPE OF PHYSICIAN AND WHETHER AN AMBULANCE IS REQUIRED
1106
IS AN AMBULANCE REQUIRED?
1108
NO
YES
SUMMON AMBULANCE
1110
ALERT AT LEAST ONE EXPERT, SENDING PATIENTS MEDICAL HISTORY, A DESCRIPTION OF THE PATIENT'S CURRENT STATE AND AN OFFER OF COMPENSATION FOR TAKING THE CASE
1112
RECEIVE "ACCEPT" OR "DECLINE" SIGNAL FROM PHYSICIAN
1114
SELECT AT LEAST ONE PHYSICIAN FROM POOL OF "ACCEPT" SIGNALS
1116
SEND CONFIRMATION SIGNAL TO ACCEPTING PHYSICIAN(S)
1118
EXIT
1120

FIG. 11

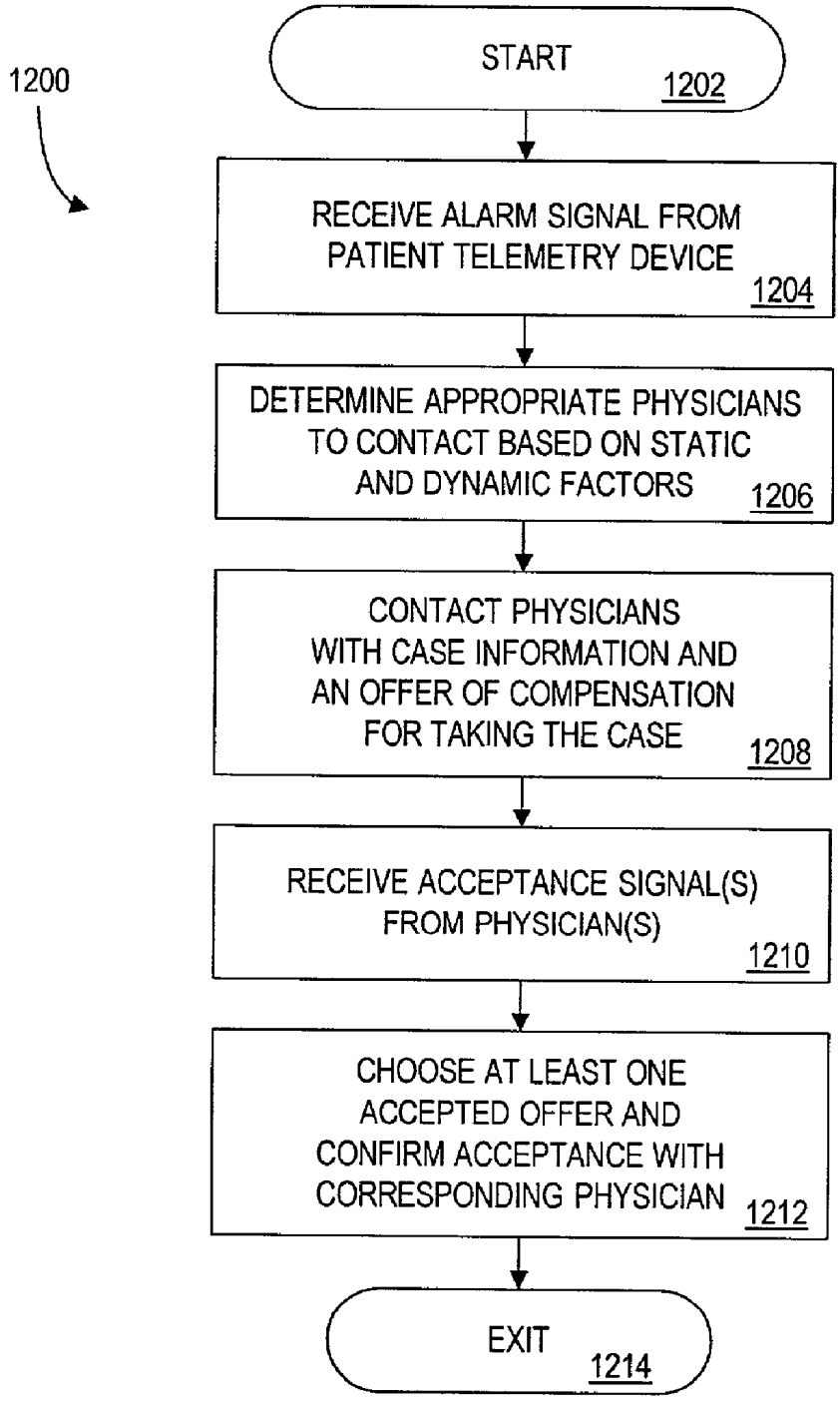

1200
START
1202
RECEIVE ALARM SIGNAL FROM PATIENT TELEMETRY DEVICE
1204
DETERMINE APPROPRIATE PHYSICIANS TO CONTACT BASED ON STATIC AND DYNAMIC FACTORS
1206
CONTACT PHYSICIANS WITH CASE INFORMATION AND AN OFFER OF COMPENSATION FOR TAKING THE CASE
1208
RECEIVE ACCEPTANCE SIGNAL(S) FROM PHYSICIAN(S)
1210
CHOOSE AT LEAST ONE ACCEPTED OFFER AND CONFIRM ACCEPTANCE WITH CORRESPONDING PHYSICIAN
1212
EXIT
1214

FIG. 12

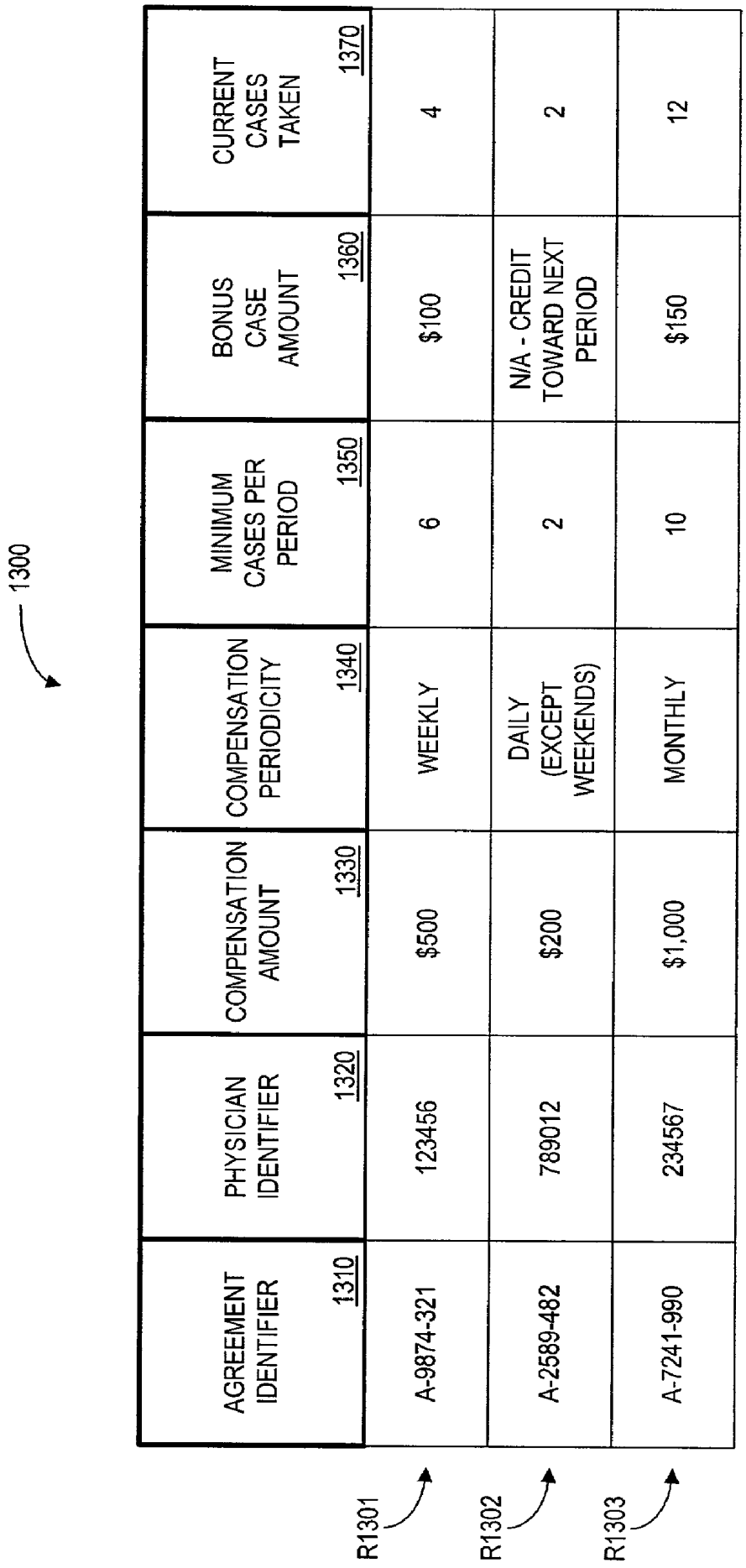

1300
AGREEMENT IDENTIFIER 1310
PHYSICIAN IDENTIFIER 1320
COMPENSATION AMOUNT 1330
COMPENSATION PERIODICITY 1340
MINIMUM CASES PER PERIOD 1350
BONUS CASE AMOUNT 1360
CURRENT CASES TAKEN 1370
R1301
A-9874-321
123456
$500
WEEKLY
6
$100
4
R1302
A-2589-482
789012
$200
DAILY (EXCEPT WEEKENDS)
2
N/A - CREDIT TOWARD NEXT PERIOD
2
R1303
A-7241-990
234567
$1,000
MONTHLY
10
$150
12

FIG. 13

PATIENT CARE DELIVERY SYSTEM

[0001] This application is a continuation-in-part of commonly-owned, co-pending U.S. patent application Ser. No. 09/282,132 entitled PATIENT CARE DELIVERY SYSTEM, filed Mar. 31, 1999, which is incorporated by reference herein in its entirety.

BACKGROUND OF THE DISCLOSURE

[0002] 1. Field of the Invention

[0003] This invention generally relates to patient care diagnosis delivery and, more particularly, to facilitating, in exchange for compensation, the provision of an expert diagnosis opinion of a condition based upon data gathered from a remote monitor.

[0004] 2. Description of the Prior Art

[0005] It is known to remotely monitor human physiological parameters such as heart rate, blood pressure, brain waves and the like in patients. Such monitoring may be accomplished using remote monitoring, thereby allowing patients to have freedom of movement. For example, some systems use cellular telephone technology to allow patients to live at home. The patient visits the hospital if the telemetry device indicates that a visit is warranted.

[0006] Hewlett-Packard's ECGStat software for its PalmVue handheld computer system allows emergency room clinicians to capture and transmit full 12-lead ECG data, including waveforms, computerized analysis and patient notes to cardiac specialists outside the hospital. It is a wireless system that uses paging technology to transmit data to a physician's handheld computer.

[0007] It is well known to use ECG monitors in conjunction with software to analyze patterns in patients' heartbeats. Typically, monitoring technicians (or monitors) are alerted to the possibility that something is amiss by an alarm. Upon examining a readout of the vital sign in question, the monitor makes a decision about (i) whether the patient requires attention (ii) whether the patient requires a cardiologist's services and if so, (iii) which cardiologist to call. Typically, the technician selects the cardiologist from a list of available specialists. This list is substantially determined by availability, i.e., who is on call at the time. If a cardiologist is required, the technician must communicate to a cardiologist the patient's condition over voice or data lines. The technician may use the Hewlett-Packard ECGStat system described above to communicate with the cardiologist.

[0008] Monitoring technicians must watch and wait for alarms to go off in all of the above-described systems. They may miss certain subtle warning signs, and if several alarms go off at once, they can only respond to one at a time. Additionally, they must find out which doctors are on call at the time and then contact the appropriate physician. If the "first choice" physician is not available, the technician must then try to contact another physician. In other words, the technician must operate in a serial manner to procure an expert opinion.

[0009] Therefore, it is seen to be desirable to provide a system able to analyze a signal from remote monitoring equipment, e.g., medical monitoring equipment, in such a way as to make a preliminary decision about whether or not an expert, such as a physician, should be contacted and to decide which physician or physicians to contact. Moreover, it is seen to be desirable to provide a system that allows physicians and other experts to accept or decline offers made by the system to render a diagnosis, thereby implementing a "piecework" type of compensation structure within the confines of, e.g., the medical environment. Preferably, such a system minimizes or eliminates the human fallibility involved in noticing alarms and contacting experts in a timely manner.

SUMMARY OF THE INVENTION

[0010] The invention is a method and apparatus for analyzing data from remote monitoring equipment, such as a patient telemetry device, and determining (i) if an anomaly exists, (ii) if an anomaly does exist, what kind of action should be taken, and (iii) if a physician should be contacted, which one. Further, the system operates in parallel, in that a plurality of experts (e.g., physicians) may be contacted in response to multiple anomalous events, thus ensuring the quickest possible response time.

[0011] The present invention further contemplates methods for obtaining opinions from a plurality of experts and aggregating such diagnoses into an aggregate diagnosis. The opinions may be rendered by experts working independently or in consultation with one another. The aggregate diagnosis is obtained in response to detection of an anomaly in data from remote monitoring equipment of a patient. The invention further contemplates various compensation schemes for providing payment to experts who provide a diagnosis.

[0012] A method for procuring a diagnosis according to the invention comprises the steps of: receiving representative data that represents at least one physiological parameter of a patient; determining whether the received data is indicative of a physiological anomaly; selecting at least one expert to provide an expert opinion regarding the indicated anomaly; communicating, to the at least one selected expert, the physiological representative data, including the determined anomaly; and receiving, from at least one selected expert, a diagnosis of the anomaly.

[0013] A diagnostic procurement system according to the invention comprises: a monitor, for monitoring at least one parameter associated with an entity and communicating data representing the at least one entity parameter; and a controller, responsive to the data representing the at least one entity parameter, for determining whether anomalous entity operational parameters are present and, in the case of anomalous entity operational parameters being present, procuring a diagnosis from at least one of a predetermined number of experts.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The teachings of the present invention can be readily understood by considering the following detailed description in conjunction with the accompanying drawings, in which:

[0015] **FIG. 1** depicts a high level block diagram of a patient care diagnosis delivery system;

[0016] **FIG. 2** depicts a high level block diagram of a central server **200** suitable for use in the patient care diagnosis delivery system of **FIG. 1**;

[0017] **FIG. 3** depicts an exemplary reaction database in tabular form suitable for use in the central server of **FIGS. 1 and 2**;

[0018] **FIG. 4** depicts an exemplary physician database in tabular form suitable for use in the central server of **FIGS. 1 and 2**;

[0019] **FIG. 5A** depicts an exemplary physician criteria database in tabular form suitable for use in the central server of **FIGS. 1 and 2**;

[0020] **FIG. 5B** depicts an exemplary patient criteria database in tabular form suitable for use in the central server **200** of **FIGS. 1 and 2**;

[0021] **FIG. 6** depicts an exemplary patient database in tabular form suitable for use in the central server **200** of **FIGS. 1 and 2**;

[0022] **FIG. 7** depicts an exemplary event database **700** in tabular form suitable for use in the central server of **FIGS. 1 and 2**;

[0023] **FIGS. 8A and 8B** depict a flow diagram of a patient care diagnosis delivery method suitable for use in the patient care diagnosis delivery system of **FIG. 1**;

[0024] **FIGS. 9A and 9B** depict a flow diagram of an expert selection method suitable for use in the patient delivery method of **FIGS. 8A and 8B**;

[0025] **FIG. 10** depicts a flow diagram of an offer processing method suitable for use in the expert selection method of **FIGS. 9A and 9B**; and

[0026] **FIG. 11** depicts a flow diagram of a patient care diagnosis delivery method **1100** suitable for use in the patient care diagnosis delivery system **100** of **FIG. 1**.

[0027] **FIG. 12** depicts a flow diagram of a patient care diagnosis delivery method **1200** suitable for use in the patient care diagnosis delivery system **100** of **FIG. 1**.

[0028] **FIG. 13** depicts an exemplary compensation agreement database in tabular form suitable for use in the central server **200** of **FIGS. 1 and 2**

[0029] To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures.

DETAILED DESCRIPTION

[0030] Applicants have recognized a need in the medical treatment community that has until now not been addressed. In one embodiment, the present invention comprises a system which carries out continuous and passive monitoring of a patient, wherein the patient's physiological parameters are monitored by a system remote from the patient and which system detects and automatically processes any recognized anomalies in such parameters, such that a potential problem may be caught and analyzed before the patient even realizes that there is anything wrong. For example the system of the present invention may detect lack of movement from a fetus or a slow-down in the heartbeat of a fetus and contact an obstetrician to determine a course of action. The obstetrician may in turn study the data and determine that such a slow-down in heartbeat is normal under the circumstances and advise the system that nothing further needs to be done. The patient being monitored can rest easier and go on about her daily activities, secure in the knowledge that her health is being continuously monitored and qualified experts are being contacted as needed. The patient does not need to worry about contacting her own physician or finding an available physician. The system has access to a multitude of qualified experts, with enormous resources to find the right expert regardless of time of day or night. Further, the system may handle the monitoring of many patients and parameters simultaneously and be capable of responding to various anomalies in different patients simultaneously such that the patient's diagnosis is not delayed unnecessarily. This is because, in at least one embodiment, the system is capable of analyzing and processing the initial physiological data automatically in order to determine what type of expert to contact, rather than being dependent on a human being to monitor physiological data and attempt to contact local physicians manually

[0031] After considering the following description, those skilled in the art will clearly realize that the teachings of the present invention can be readily utilized in any environment in which an entity (e.g., a patient) having at least one monitored operating parameter (e.g., physiological parameter) may require an expert diagnostic or other opinion if one or more of the monitored operating parameters indicates that an operating anomaly is present. The system and method provide (a) an initial screening and decision capability based upon the received operating data sufficient to determine which type of expert is needed; (b) an identification and communication of at least a portion of the operating data to one or more appropriate experts; (c) a transactional capability defining a level of compensation to be provided to the expert in exchange for the rendering of an expert diagnosis regarding the anomaly; and (d) an adaptation of an existing communications infrastructure to the procurement of the expert opinion(s).

[0032] While the invention will be primarily described within the context of a medical monitoring system, it will be appreciated by those skilled in the art that the invention has applicability well beyond the patient care diagnosis delivery system described herein. Specifically, the invention comprises, in general terms, a centralized system procuring expert diagnosis or diagnostic opinion(s) in response to remotely monitored data indicative of an event requiring such an opinion.

[0033] Throughout this description various terms are used to describe the invention. Unless modified by the following description, several of the terms are defined as follows: An anomaly comprises a dysfunction or precursor to a dysfunction within a monitored entity, such as a patient in a medical monitoring environment. An "expert" is an entity that provides a diagnosis relating to an anomaly. An expert is one deemed by the patient and, optionally, the system, as having expertise in treating the patient's condition. In the case of standard medical specialties, the patient and system will be in agreement as to the definition of an expert. If the patient believes in practitioners of non-standard or alternative therapies, then the system and patient may disagree. A "diagnosis" or diagnostic opinion comprises an identification of an anomaly, a recommended treatment for a patient or any expert opinion tending to remediate or ameliorate an anomalous condition. "Communication" comprises any means of transferring data to or from a communicating party, such as a patient telemetry device, a central server, a physician

terminal device, a computing device or telephonic device and the like. A communication may utilize encryption/decryption protocols. "Alert information" comprises information, including local diagnostic information, real time physiological data and other information intended to be used in the rendering of a diagnosis or a determination of the type of expert needed to render such a diagnosis. A data profile is a data template against which raw or processed information is compared to produce a level of affinity between the information and the data profile. A high level of affinity indicates that the information may conform to an anomalous condition associated with the data profile. Profiles may be individualized and adapted to patients. For example, a baseline profile may be adapted over time in response to a patient's improving or degrading condition (e.g., diminished heart valve integrity will lead to changes in ECG data as the heart adapts by pumping harder and/or differently).

[0034] **FIG. 1** depicts a high level block diagram of a patient care diagnosis delivery system. Specifically, **FIG. 1** depicts a high level block diagram of a patient care diagnosis delivery system **100** comprising a plurality of physician terminal devices **110-1** through **110**-N, a central server **200** and a plurality of patient telemetry devices **120-1** through **120**-N.

[0035] Each of the plurality of patient telemetry devices **120-1** through **120**-N is capable of monitoring at least one physiological parameter of a patient and communicating data representative of the monitored parameter to the central server **200** via respective data paths P1 through PN. The patient telemetry device may comprise a known device capable of monitoring patient data, transmitting that data to the central server and, optionally, receiving data from the central server **200**.

[0036] The central server **200** examines the communicated data to determine if the at least one physiological parameter is within appropriate or "normal" parameter boundaries. If the data is not within the appropriate boundary, the central server **200** determines if an event or medical anomaly (e.g., cardiac arrest or other condition) may be occurring. If such a determination is made, then the central server **200** communicates an offer to one or more of the physician terminal devices via respective data paths E1 through EN.

[0037] Each physician terminal device **110** (i.e., physician terminals **110-1** through **110**-N) is associated with at least one respective expert, such as physician(s), nurse(s), and other experts. A physician receiving an offer accepts that offer by communicating an acceptance message to the central server **200** via the physician terminal device **110** or another means (e.g., telephone, computer network and the like). The central server then decides which one (or more than one) of the accepted offers will be confirmed by sending a confirmation signal to the physician via, e.g., the respective physician terminal device(s). The physician terminal device may comprise a known device capable of receiving information from the central server and, optionally, transmitting information to the central server **200**. For example, a pager, a personal digital assistant (PDA) or a cellular telephone may be utilized for this purpose.

[0038] An exemplary embodiment of a patient telemetry device **120-1** comprises an input/output (I/O) circuit **125**, support circuitry **123**, a processor **124**, a memory **126** and a data link **127**. The processor **124** cooperates with conventional support circuitry **123** such as power supplies, clock circuits, cache memory and the like as well as circuits that assist in executing the various software routines within the patient telemetry device **120-1**. Input/output circuit **125** forms an interface between the patient telemetry device **120-1** and sources of patient physiological data. For example, the input/output circuit **125** may comprise sensors, transducers and other analog to digital conversion circuitry adapted to measure physiological parameters associated with a patient, such as heart rate, blood pressure, temperature, perspiration level, respiratory activity, body electrical activity, brain activity and the like. The physiological information is received and/or processed by the input/output circuitry to produce physiological parameter representative data in a form usable by processor **124**. The processor **124** communicates the physiological parameter representative data to the central server **200** via a data link **127**.

[0039] Data link **127** comprises a wireless or a non-wireless data link (e.g., a telephone dialer, a cellular telephone link, or a computer link) or other communications link driver suitable for providing patient data to the central server **200** via a respective data path (e.g., data path P1). The patient telemetry device is optionally responsive to a patient control signal. The patient control signal comprises a signal that a patient may use to communicate specific information or a request to the central server **200**. For example, in the case of a patient sensing the onset of some physiological anomaly (e.g., the beginning of cardiac arrest) or the patient suffering a trauma (such as a fall), the patient may manually communicate this condition to the central server **200** such that appropriate action (e.g., summon an ambulance) is taken. The patient control signal is produced by an optional input device **145**, illustratively, a key pad. The patient control signal is used to communicate a message to the central server **200** comprising, e.g., a standby mode message, an impending exertion message, an equipment failure message, a medical emergency message, a non-medical emergency message, a specific physiological dysfunction message and a test message. In response to such a message, the system may choose to ignore any apparent anomalies.

[0040] An exemplary embodiment of a physician terminal device **110-1** comprises an input/output (I/O) circuit **115**, support circuitry **113**, a processor **114**, memory **116**, a display device **111** and a data entry device **112**. The processor **114** cooperates with conventional support circuitry **113** such as power supplies, clock circuits, cache memory and the like as well as circuits that assist in executing various software routines. The physician terminal device **110-1** also contains input/output circuitry **115** that forms an interface between the physician terminal device **110** and the central server **200**. The display device **111** comprises a liquid crystal display (LCD) or other display means, while the data entry device **112** comprises a keyboard or other data entry means. The memory **116** includes a standard control program such as a PDA or cellular telephone control program that enables a physician or expert interacting with the physician terminal device to receive information from the central server **200** and, optionally, transmit information back to the central server **200**.

[0041] Referring now to the patient telemetry device **120-1**, in one embodiment of the invention, the physiological information received from the patient is merely converted into a digital information stream, either compressed or

uncompressed, and transmitted directly to the central server **200**. That is, the patient telemetry device **120** does not perform any analysis of the physiological data. The data is merely passed to the central server **200** in either a compressed or uncompressed data format as appropriate to, e.g., the format of data link P1. Compressed data transfer may be effected using various compression methods, such as the frequency domain transform functions utilized in known communications systems.

[**0042**] In another embodiment of the invention, the processor **124** performs an analysis of the received physiological information to determine if, for example, monitored parameters of the patient are within appropriate boundaries. For example, the processor **124** may be programmed (via a control program within the memory **126**) to issue an alert to the central server **200** in the event of a patient heart rate exceeding an upper threshold level or dropping below a lower threshold level. Multiple parameter alarms may be programmed such that particular combinations of physiological parameter levels trigger specific alerts indicative of specific conditions.

[**0043**] In another embodiment of the invention, the patient telemetry device **120-1** and central server **200** communicate bi-directionally. In this embodiment, parameter threshold levels are optionally updated via the data link (P1-PN) or other means (e.g., via an internet or telephone connection) such that patient monitoring may be calibrated to the changing needs of a patient. For example, if a patient is about to exercise, it is quite likely that the measured heart rate will increase. Therefore, the patient may communicate this fact to the central server **200** via a patient control signal produced using the keypad **145**. Bi-directional communication may be effected via the internet **170** or other communications medium.

[**0044**] In another embodiment of the present invention utilizing bi-directional communication with the central server **200**, the patient telemetry device **120-1** is associated with a drug dispensing device **130**. In this embodiment of the invention, the central server **200** may be used to control the dispensing of drugs to the patient via the drug dispensing device **130**. For example, in the case of a patient exhibiting physiological information indicative of cardiac arrest, the central server **200** may cause the drug dispensing device **130** to dispense medication tending to reduce or mitigate any harm to the patient due to the event. In the case of local analysis by the patient telemetry device **120**, the decision to dispense medication may be made locally. Additionally, medication dispensing may be placed under the control of the patient (e.g., pain medication up to a predefined dosage rate). Optionally, the local control of medication dispensing is communicated to the central server **200** where the patient's medical records are responsively updated.

[**0045**] In another embodiment of the present invention utilizing bi-directional communication with the central server **200**, the patient telemetry device **120** is associated with a global positioning system (GPS) locator **135**. The GPS locator **135** comprises known GPS receiver circuitry suitable for determining the geographic position of the patient (assuming the patient is near the GPS locator). The geographic position of the patient is transmitted to the central server **200** for use in, e.g., directing an ambulance to the patient, performing geographical-based analysis of aggregated patient data or other functions.

[**0046**] In another embodiment of the invention utilizing bi-directional communication with the central server **200**, the patient telemetry device **120** is associated with an automatic external defibrillator (AED) **140**. In the event of the physiological information of the patient being indicative of, e.g., a ventricular fibrillation, a central server or decision may indicate that defibrillation is appropriate. In this case, the central server or patient telemetry device causes the automatic external defibrillator to enter an active mode of operation. Present automatic external defibrillators include monitoring capabilities such that they do not administer an electric shock to a patient unless such an electric shock is warranted. That is, present automatic external defibrillators perform monitoring operations to confirm the need for a defibrillation. Such functionality may optionally be incorporated into the patient telemetry device **120**.

[**0047**] In another embodiment of the invention, a security system **150** associated with the patient is coupled to the patient telemetry device **120** such that in the event of a medical emergency, the central server **200** is contacted and, additionally, a security system server (not shown) is also contacted. In this embodiment of the invention, where a patient is paying a monitoring fee to a security system service, the data link **127** may communicate to the central server **200** via the security system **150** rather than the data link **127** (e.g., telephone lines, cellular telephone, two-way paging and the like).

[**0048**] In another embodiment of the invention, a medical records clearing-house **180** is used to store patient medical records. In this embodiment of the invention, the patient medical records are communicated to a confirmed expert (i.e., a physician accepting an offer that has been subsequently confirmed) via the internet **170** or via the central server **200**.

[**0049**] **FIG. 2** depicts a high level block diagram of a central server **200** suitable for use in the patient care diagnosis delivery system of **FIG. 1**. Specifically, the central server **200** of **FIG. 2** comprises a communications port **210**, a processor **220**, a memory **230**, support circuitry **240** and a storage device **250**. The communication port **210** forms an interface between the central server **200** and the physician terminal devices **110-1** through **110-N**, the patient telemetry devices **120-1** through **120-N** and, optionally, the internet **170** and the medical records clearinghouse **180**. The processor **220** cooperates with support circuitry **240** and memory **230** to run various programs **1200** and use various databases **300-700** stored in storage device **250**. Specifically, the storage device **250** is used to store a program **1200** that will direct the processor **220** to perform the methods of the present invention and to store various databases **300-700** used to implement the methods of the present invention. In an exemplary embodiment, the storage device **250** is used to store a reaction database **300**, a physician database **400**, a criteria database **500**, a patient database **600**,an event database **700**, and a compensation agreement database **800**. The reaction database **300** will be discussed in more detail below with respect to **FIG. 3**, the physician database **400** will be discussed with more detail below with respect to **FIG. 4**, the criteria database **500** will be discussed in more detail below with respect to **FIGS. 5A and 5B**, the patient database **600** will be discussed in more detail below with respect to **FIG. 6**, the event database **700** will be discussed in more detail below with respect to **FIG. 7**, and the compensation agree-

ment database will be discussed in more detail below with respect to **FIG. 13**. It should be noted that the programs and databases may be stored locally in the central server **200** or in a remote location, such as the optional medical records clearing house **180** depicted in **FIG. 1**.

[**0050**] The operation of the central server **200** will be described in more detail below with respect to FIGS. **8-12**. Briefly, in one embodiment of the invention the central server **200** receives a continuous signal from each patient; the received signal is analyzed to determine if any predefined patterns or data aberrations exist; any such patterns or data aberrations are further analyzed to determine whether the pattern or data aberration is pathological; if pathological, then the central server **200** searches the physician database for an expert, such as a physician, appropriate to the treatment of patients exhibiting such pattern or data aberration and, if appropriate, an ambulance is dispatched to bring the patient to a hospital; the expert is then paged and offered compensation to render an expert diagnosis on the patient's condition; in the case of an expert accepting the offer, the central server **200** confirms the acceptance and transmits to the expert a copy of at least a portion of the patient's medical history and a description of the current pattern or data aberration so that the expert diagnosis may be rendered.

[**0051**] **FIG. 3** depicts table **305**, exemplary of reaction database **300**, suitable for use in the central server of **FIGS. 1 and 2**. Specifically, the table **305** of **FIG. 3** comprises a plurality of records R**31** through R**36**, each record being associated with a respective alert field **310** and a respective system reaction field **320**. The alert field **310** of a record indicates a specific alert condition. The system reaction field **320** of the record indicates an appropriate system reaction to the corresponding alert field **310** of the record.

[**0052**] It is noted that the alert fields **310** of the table **305** of **FIG. 3** assume that the patient telemetry devices **120** of the system **100** of **FIG. 1** provide alert information to the central server **200**. That is, the patient telemetry devices **120-1** through **120**-N perform a local data analysis (or receive direct patient input) and responsively issue an alert code to the central server. The table **305** provides, for each predefined alert, an appropriate system response to the alert. Additionally, the table **305** of **FIG. 3** is shown with only six records (R**31** through R**36**). However, it will be appreciated by those skilled in the art that the reaction database **300** may comprise an unlimited number of records.

[**0053**] Alert field **310** of records R**31** through R**36** is depicted as indicating alert conditions as follows: ventricular fibrillation R**31**; loss of consciousness R**32**; aberrant blood glucose levels R**33**; fetal heart monitor alarm R**34**; tachycardia R**35**; and acutely high blood pressure R**36**.

[**0054**] System reaction field **320** of records R**31** through R**36** is depicted as indicating the following system responses to corresponding alert conditions as follows: summon an ambulance and offer the case to one or more cardiologists R**31**; summon an ambulance and offer the case to an emergency room physician R**32**; instruct the patient to take insulin and, if the blood glucose levels do not return to normal after a predefined period of time (e.g., 15 minutes,) offer the case to one or more nurses R**33**; alert the mother, instruct her to go to the hospital and offer the case to one or more obstetricians R**34**; offer the case to one or more cardiologists and query the patient as to the patient's present activity level (e.g., was patient climbing stairs, playing basketball, watching television and the like) R**35**; and offer the case to one or more internists and query the patient as to a present activity level R**36**.

[**0055**] **FIG. 4** depicts table **405**, exemplary of physician database **400** suitable for use in the central server of **FIGS. 1 and 2**. Specifically, the table **405** of **FIG. 4** comprises a plurality of records R**41** through R**49**, each record being associated with a respective physician's name field **410**, a physician identifier field **420**, a physician criteria codes field **430**, a specialty field **440**, a previous case identifiers field **450**, an availability field **460** and a contact information field **470**. It should be noted that the availability field **460** may provide conditional information, i.e., an unavailable physician will always be available if a compensation level exceeds a threshold amount such as illustrated in record R**48**.

[**0056**] For each record, the physician's name field **410** indicates the name of a particular physician; the physician identifier field **420** indicates an insurance company, hospital or other identification number or code that uniquely identifies the physician; the physician criterion codes field **430** indicates physician criterion information (e.g., fee structure, board certification and the like); the specialty field **440** indicates the physician's specialty (e.g., Cardiology, Surgery and the like); the previous case identifiers field **450** indicates the case identifiers of previous cases handled by the physician; the availability field **460** indicates whether the physician is presently available to handle a case; and the contact information field **470** indicates the preferred method of contacting the physician, e.g., voice, pager, email and the like. Physicians indicate their availability by, for example, logging onto a web site or otherwise communicating by alternate means with the system to inform the system when they become available and when they cease to be available.

[**0057**] Record R**41** of table **405** indicates that a physician named John Doe has a corresponding identifier "123456", criterion codes "UH", "BS", "M33" and "MP", a specialty of "Emergency Medicine", previous case identifiers of "C987654", "C876543" and "C765432", an availability indication of "yes" and contact information indicative of a pager number of 555-1234. Record R**42** indicates that a physician named Bob Smith has a corresponding identifier "234567", criterion codes "UH", "M33" and "MP", a specialty of Cardiology, previous case identifiers of "C654321", "C543210" and "C432109", an availability indication of "no" and contact information indicative of a voice number of 555-2345.

[**0058**] Records R**43** through R**49** contain similar data regarding other physicians. The physician criterion codes field **430** will be discussed in more detail below with respect to **FIG. 5A**. For example, Record R**48** of table **405** indicates that a physician named Alex Schwartz has a corresponding identifier "890123", criterion codes "UH", "BS", "BC" and "MP", a specialty of "Endocrinology", previous case identifiers of "C999876" and "C888765", an availability indication of "only above $150" (i.e., only available if offer is at least $150) and contact information indicative of an email address of good_doc@hospital.com. The previous case identifier field **450** will be discussed in more detail below with respect to **FIG. 7**.

[0059] **FIG. 5A** depicts table **500**A, exemplary of one embodiment of criteria database **500** suitable for use in the central server of **FIGS. 1 and 2**. Specifically, the table **500**A of **FIG. 5A** comprises a plurality of records RA**51** through RA**58**, each record being associated with a respective physician criterion field **510** and a physician criterion code field **520**.

[0060] For each record RA**51** through RA**58**, the physician criterion field **510** indicates a particular objective or subjective criterion that may be applied to a physician. Subjective physician criteria comprise subjective preferences of the physician (e.g., preferred patients, insurance plans, hospitals and the like). For each record RA**51** through RA**58** the physician criterion code field **520** contains the corresponding code, or abbreviation, of the objective or subjective criterion contained within the respective physician criterion field **510**. If a criterion is applicable to a given physician, the code for that criterion will appear in the physician criterion codes field **430** of a record associated with that physician in the physician database **400**.

[0061] The contents of the physician criterion field **510** and the physician criterion code field **520** of records RA**51** through RA**58** are as follows: a physician criterion of universal health approved physician criterion is associated with code UH (record RA**51**); Blue Shield approved physician criterion is associated with code BS (record RA**52**); board certified physician criterion is associated with code BC (record RA**53**); fee structure in upper 33rd percentile criterion is associated with code U33 (record RA**54**); fee structure in middle 33rd percentile criterion is associated with code M33 (record RA**55**); fee structure in lower 33rd percentile criterion is associated with code L33 (record RA**56**); male physician criterion is associated with code MP (record RA**57**) and female physician criterion is associated with code FP (record RA**58**).

[0062] **FIG. 5B** depicts a table **500**B, exemplary of another embodiment of criteria database **500** suitable for use in the central server **200** of **FIGS. 1 and 2**. Specifically, table **500**B of **FIG. 5B** comprises a plurality of records RB**51** through RB**514**, each record being associated with a respective patient criterion field **530** and a patient criterion code field **540**.

[0063] For each record, the patient criterion field **530** indicates a particular objective or subjective criterion applied to a physician treating a patient that is required or preferred by the patient or the patient's insurance provider. Subjective criteria comprises subjective preferences of the patient (e.g., preferred physicians, preferred hospitals and the like). The patient criterion code field **540** of a record contains the code, or abbreviation, of the objective criterion contained within the respective patient criterion field **530**. A physician having a criterion code contrary to a required patient criterion code is deemed to be undesirable to the patient. A physician having all criterion codes matching those of the patient is deemed to be most desirable to the patient. Physicians having some criterion codes matching the patient preferred criterion codes may be ranked in order of preference according to the amount of correlation between the patient's and physicians' criterion codes.

[0064] The contents of the patient criterion field **530** and the patient criterion code field **540** of records RB**51** through RB**514** are as follows: require universal health approved physician criterion is associated with code R-UH (record RB**51**); prefer universal health approved physician criterion is associated with code P-UH (record RB**52**); require Blue Shield approved physician criterion is associated with code R-BS (record RB**53**); prefer Blue Shield approved physician criterion is associated with code P-BS (record RB**54**); prefer fee structure in upper 33rd percentile criterion is associated with code P-U33 (record RB**55**); prefer fee structure in middle 33rd percentile criterion is associated with code P-N33 (record RB**56**); prefer fee structure and lower 33rd percentile criterion is associated with code P-L33 (record RB**57**); require board certification criterion is associated with code R-BC (record RB**58**); prefer board certification criterion is associated with code P-BC (record RB**59**); require m ale physician criterion is associated with code R-MP (record RB**51**O); prefer male physician criterion is associated with code P-MP (record RB**511**); require female physician criterion is associated with patient code R-FP (record RB**512**); prefer female physician criterion is associated with code P-FP (record RB**513**) and require first available physician criterion is associated with criterion code R-FA (record RB**514**).

[0065] **FIG. 6** depicts a tabular representation **605** of an exemplary patient database **600** suitable for use in the central server **200** of **FIGS. 1 and 2**. Specifically, the table **605** of **FIG. 6** comprises a plurality of records R**61** through R**68**, each record being associated with a respective patient's name field **610**, patient identifier field **620**, patient criterion code field **630**, a "currently being treated for" field **640** and a past alerts field **650**.

[0066] For each record R**61** through R**68**, the patient's name field **610** indicates the name of a particular patient; the patient identifier field **620** indicates an insurance company, hospital or other identification number or code that uniquely identifies the patient; the patient criterion codes field **630** indicates patient criterion information relating to preferred objective or subjective characteristics of a treating physician (e.g., fee structure, board certification and the like); the currently being treated for field **640** indicates the current medical conditions (if any) that the patient is currently being treated for and the past alerts field **650** indicates the medical conditions (or general health) that triggered previous alerts or other events.

[0067] A number of exemplary patient criteria appear in this database. The codes for patient criteria correspond to those for physician criteria, except that patient codes have either an "R" or "P" prefix. For example, the code for a board-certified physician is BC; the patient codes for board-certified physicians are R-BC and P-BC. Patient criterion codes with "R" prefixes indicate that the patient requires the criterion corresponding to this code. Patient criterion codes with "P" prefixes indicate that the patient prefers but does not require this criterion. Some patient criteria, such as requiring the response of the first available physician, do not have corresponding physician criteria codes.

[0068] Entries in the patient criterion codes field **630** may be determined not only by the patient, but, optionally, by the patient's family physician, insurance company or other entity. The currently being treated for field **640** contains brief information about the patient's current medical conditions. A "general health" entry in this field indicates that the patient is not currently being treated for anything in par-

ticular, but is instead being monitored just in case any problems develop. In one embodiment of the invention, a patient's medical records are sent to a physician by providing the physician with a hyperlink or data path, such that the physician can access the files directly from a computer terminal connected to the internet or other computer network.

[0069] Record R66 of table **605** indicates that a patient Matt Smith is associated with an identifier number "678901", criteria codes P-MP, P-U33 and P-BC, is currently being treated for "general health" (i.e., no particularized ailment) and lost consciousness during a past alert on Jan. 1, 1998. Record R67 of table **605** indicates that a patient Teun Van Vliet is associated with an identifier "789012", criteria codes R-UH and P-L33, is currently being treated for "Arteriosclerosis" and has never been associated with an alert. Record R68 of table **605** indicates that a patient Ana Ng is associated with an identifier "890123", criteria codes R-BS, P-BC and R-FP, is currently being treated for "Possible Pregnancy Complications" and has never been associated with an alert. Records R61 through R65 contain respective data relating to other patients.

[0070] **FIG. 7** depicts a table **705**, exemplary of event database **700**, suitable for use in the central server of **FIGS. 1 and 2**. Specifically, the table **705** of **FIG. 7** comprises a plurality of records R71 through R74, each record being associated with a respective date field **710**, case identifier field **720**, patient identifier field **730**, physician identifier field **740**, event description field **750**, outcome field **760**, offers made field **770** and offers accepted field **780**. The offers made field **770** and offers accepted field **780** include respective physician identifiers and compensation value offered sub-fields.

[0071] The date field **710** indicates the date of a particular event. The case identifier field **720** identifies, by a unique case identifier, the particular event. The patient identifier field **730** and physician identifier field **740** identify, respectively, the patient and physician involved in the event. The event description field **750** includes a description of the event. The outcome field **760** includes information defining the outcome of the event (e.g., the patient was admitted to a hospital, treated in a particular manner, administered a certain drug and the like). The offers made field **770** include information identifying each physician to whom an offer of compensation in exchange for diagnostic services was made, and the amount of money offered for such services. The offers accepted field **780** includes information indicating which physician or physicians accepted the offer and at what compensation value they accepted the offer. Optionally, a "past alerts" field contains a record of previous alerts and is used to ascertain whether certain patients (or devices) are prone to false alarm events.

[0072] The offers made field **770** and offers accepted field **780** are optionally used to improve the system accuracy in predicting physician demand and prices. For example, the system may determine that physician "596143", an internist, regularly accepts offers $50 below the median offer for internists. In this scenario, offers to this physician may be reduced. By graphing acceptance rate against offer values, time of day and other factors, the system continually absorbs information relating to the contracting behavior of physicians, thereby refining estimates of demand and appropriate prices.

[0073] Record R71 of table **705** indicates that on Jan. 1, 1998 a case "678901A" involving a patient "678901" and a physician "123456" involved a loss of consciousness. A first physician "123456" was offered $180, a second physician "789012" was offered $200 and a third physician "406961" was offered $220 to accept the case. The first physician "123456" and the second physician "789012" accepted the case at the offered amount. The event resulted in an admission to a hospital for a narcotics overdose.

[0074] Record R72 of Table **705** indicates that on Jan. 11, 1998 a case "505995A" involving patient "505995" and physician "**567890**" involved an event of acute high blood pressure and had an outcome of the patient being queried and found him to be exercising. A physician identified as "234567" was offered $375, a second physician identified as "567890" was offered $375 and a third physician identified as "961642" was offered $385 to take the case. The first and third physicians accepted the offers at the offer price.

[0075] Record R73 of Table **705** indicates that on Feb. 14, 1998 case "381884A" involving patient "381884" and physicians "**567890**" and "234567" involved a tachycardia event with an outcome of hospital admission for the patient. Physician "567890" was offered $350 and physician 234567 was offered $375 for taking the case. Both physicians accepted the offer at the respective offer price.

[0076] Record R74 of Table **705** indicates that on Mar. 15, 1998 case "567890A" involving patient "567890" and physician "234567" involved an event of acute high blood pressure and resulted in an emergency room administration of appropriate drugs and a release of the patient. A first physician "234567" was offered $350 and a second physician "567890" was offered $375 for taking the case. The first physician "234567" was subsequently offered $375 and then $400 for taking the case. Physician "234567" finally accepted the $400 offer price.

[0077] **FIGS. 8A and 8B** depict a flow diagram of a patient care diagnosis delivery method suitable for use in the patient care diagnosis delivery system of **FIG. 1**. Specifically, the patient care diagnosis delivery method **800** of **FIGS. 8A and 8B** is suitable for use within the central server **200** of the patient care diagnosis delivery system **100** of **FIG. 1** and **FIG. 2**.

[0078] The method **800** is initiated at step **802**. At step **804** a telemetry signal is received from a patient. As previously noted with respect to **FIG. 1**, the telemetry signal may comprise compressed or uncompressed physiological data without local analysis, compressed or uncompressed physiological data with a local analysis (i.e., including an alarm code), a control signal produced by the patient and, optionally, other data.

[0079] At step **806** a determination is made as to the appropriate reaction of the patient care diagnosis delivery system **100**. In the case of compressed or uncompressed physiological data without local analysis, the data is analyzed to determine if patterns within the data are indicative of a present or pending (i.e., precursor indications of dysfunction) physiological dysfunction. This analysis may be conducted using one or more of a number of known data analysis techniques. In the exemplary embodiment, the analysis is conducted by comparing portions of the data to data profiles that have been determined to be indicative of

such present or precursor physiological dysfunction. In the case of compressed or uncompressed physiological data with local analysis (e.g., alarm codes), the received alarm code is compared to the alert field **310** of the records within the reaction database **300**. A favorable comparison to a record yields, from the system reaction field **320** of that record, the appropriate response to the received alarm code. It should be noted that the data profiles may be periodically updated or altered.

[**0080**] In the case of compressed data that has been compressed using a frequency transform compression scheme, the step of comparing the compressed data may be performed within the compressed data domain (i.e., frequency domain) by performing the following steps: transforming, using a frequency domain transform function, the data representative of the physiological parameter; and correlating, against each of a plurality of frequency domain profiles, the transformed data representative of the physiological parameter, where each of the frequency domain profiles is associated with at least one pathological anomaly.

[**0081**] A control signal produced by the patient is also reacted to in a predefined manner based upon the signal. For example, a control signal indicative of pending patient exercise indicates to the central server **200** that a subsequent increase in blood pressure is to be expected, though the system will still react appropriately to data indicative of cardiac arrest.

[**0082**] At step **808** a query is made as to whether the determination at step **806** indicates that the received telemetry signal should be ignored. If the query at step **808** is answered affirmatively (e.g., elevated blood pressure during exercise), then the method proceeds to step **809** where, optionally, an entry in an error log (not shown) is made and the method proceeds to step **804** where the next telemetry signal is received. If the query at step **808** is answered negatively, then the method **800** proceeds to step **812**. Optionally, if the query at step **808** is answered negatively, then the method **800** proceeds to step **810**, where an ambulance is dispatched to the patient's location, if needed. The patient's location may be determined with respect to a known location or, in the case of a patient telemetry device **120** associated with a GPS locator **135**, GPS data within the received signal will provide location information.

[**0083**] At step **812** one or more experts are selected to provide diagnostic services. The expert(s) selected to provide such services are selected based upon the physician criterion **500**A of **FIG. 5**A and patient criterion **500**B of **FIG. 5**B, as will be discussed in more detail below with respect to **FIGS. 9A and 9B**.

[**0084**] Briefly, the above-mentioned criteria result in a patient preference ranking of physicians, as modified by patient insurance company requirements, according to medical specialty, gender, fee structure and the like. Patient preference ranking is based upon a patient criterion within patient criterion database **500**B. Physician preference ranking is based upon the physician criterion database **500**A. Insurance company preference ranking is based upon insurance company information within either of the patient criterion database **500**B or physician criterion database **500**A or other database. For example, insurance companies may have negotiated or predefined contractual arrangements with individual physicians, physician groups and/or hospitals or hospital systems. In the case of a preferred hospital system or other medical facility, an insurance company may have preferred providers within that facility and these providers may or may not be reflected in the patient preference rankings. However, since the insurance company associated with a particular patient is likely to be the one paying the bill, it is prudent to adapt the selection of experts to the insurance company preference ranking to the extent possible. The specialty of an expert selected to provide diagnostic information may be dependent upon, e.g., the received telemetry signal from the patient and/or the patient's medical data or history. In the case of an emergency situation or emergent event, it may be necessary to immediately secure some expert opinion, regardless of physician specialty or other preferential ranking. These criteria or other criteria may be combined to produce a combined ranking that may be weighted in a manner tending to favor insurance company preferences, patient preferences, physician preferences and other factors as deemed appropriate.

[**0085**] At step **814** at least a portion of the patient's data is provided to the selected expert or experts. The patient data may comprise, e.g., the received telemetry signal, the patient's medical history and any other data appropriate or necessary to the selected experts in rendering their diagnosis.

[**0086**] At step **816** the diagnoses from the expert or experts is/are received. The method **800** then proceeds to optional step **818**, where an aggregated diagnosis is formed using a plurality of diagnoses rendered by a respective plurality of experts. The aggregated diagnosis forms a "most likely" diagnosis that is used to determine an appropriate course of treatment for the patient in one embodiment of the present invention.

[**0087**] Forming an aggregate diagnosis may, in one embodiment, comprise selecting the diagnosis that the majority of the experts agree on. For example, if 3 out of 5 experts recommend the patient proceed to the emergency room immediately for certain treatment while the other two experts recommend 24 hours of bedrest before a trip to the emergency room is determined to be necessary, the system may select the diagnosis of the majority and instruct the patient to immediately proceed to the emergency room or summon an ambulance to the patient's location. In such an embodiment the patient may only be informed of the majority opinion selected by the system or may be provided with the two alternate diagnoses and asked to select which diagnosis he wants to proceed according to. Alternatively, at the time of the event the patient may be informed of the majority diagnosis but may at a subsequent time be informed of any alternate diagnosis that was not selected.

[**0088**] In an aggregate diagnosis embodiment the experts involved in a particular case may render independent diagnoses independently of one another or may be allowed (or required) to confer with one another in rendering the aggregate diagnosis. For example, the experts may be able to communicate through the internet **170** of system **100** in order to confer or share opinions in rendering the aggregate diagnosis. In an embodiment where the experts are each independently rendering a diagnosis which is aggregated with the other diagnoses by the system, the experts may or may not be aware that their diagnosis is part of an aggregate diagnosis.

[0089] An aggregate diagnosis embodiment may help instill more confidence in the patient and may shield any one individual expert from sole liability for rendering a remote diagnosis. An aggregate diagnosis may also introduce quality assurance into the system of the present invention. Another form of quality assurance may be to have another expert review or approve a diagnosis before it is acted upon by the system. Such review or approval may be performed (i) in every case, (ii) in random or selected cases, and/or (iii) for cases involving experts who are new to the system or against complaints or grievances have been lodged.

[0090] After receiving an expert diagnosis (step **816**) or forming an aggregated diagnosis (step **818**), the method **800** proceeds to step **819**, where the diagnosis is communicated to the patient, and to step **820**, where the expert or experts providing the diagnosis is compensated. The expert compensation may be based upon one of, per step **822**, a flat rate, an hourly rate, and a per event rate. Optionally, the compensation may be based upon the time of day (e.g., higher compensation between 10:00 PM and 8:00 AM) or upon physician availability. Optionally, the compensation may be adjusted in the case of a complex event or an especially favorable outcome. A complex event comprises, e.g., an event implicating several specialties or sub-specialties or otherwise causing the expert being so compensated to devote a significantly higher level of time and/or effort to a particular event. A favorable outcome comprises an especially efficient outcome (either monetarily or physiologically) or other superb outcome based upon, e.g., an especially high level of skill applied to an event by an expert being compensated. In emergent situations, an expert may incur a "lost opportunity" cost by handling the case (i.e., failing to gain a greater compensation for another activity so that an emergency event is properly handled). In such cases an additional compensation may be provided.

[0091] Compensation may be determined by a rules-based method where, for example, the rules for determining a compensation to offer or an adjustment to previously offered or accepted compensation is determined by applying predetermined rules. Such rules may be programmed into the software running on the system of the present invention or stored in a database utilized by the system. For example, compensation may start from a base amount and may be adjusted from this amount based on the circumstances of a case. Circumstances that may be taken into consideration may include, for example, (i) a previously established rate between the expert and the system, (ii) certain qualifications or criteria associated with the expert, (iii) the severity or urgency of the patient's potential condition, and (iv) how many other experts are available to render a diagnosis. The adjustment of the base amount may be an upward or downward adjustment in such an embodiment. Alternatively, an amount of compensation may be determined, for example, based on a formula that takes certain variables (e.g. qualifications of expert, expert's history of accepting offers) into account when calculating a compensation amount to offer or an adjustment to a compensation amount.

[0092] Returning now to **FIG. 8**B, at step **824** the patient database **600**, physician database **400**, and event database **700** is updated. The method **800** then proceeds to step **804** to await the next telemetry signal from a patient.

[0093] It should be noted that the above-described method **800** is applicable to the situation where many cases are handled at once. That is, where many patients are associated with patient telemetry devices providing a substantially continuous flow of information to the server.

[0094] **FIGS. 9A and 9B** depict a flow diagram of an expert selection method suitable for use in the patient care delivery method of **FIGS. 8A and 8B**. Specifically, the expert selection method **900** of **FIGS. 9A and 9B** is suitable for use in implementing, e.g., step **812** of the patient care delivery method **800** of **FIGS. 8A and 8B**.

[0095] The expert selection method **900** is initiated at step **902** and proceeds to step **904**. At step **904** patient data and patient criteria codes for the patient transmitting the telemetry signal received at step **804** are retrieved from, respectively, patient database **600** and patient criteria database **500**B.

[0096] At step **906** a determination is made as to the appropriate and available experts based upon the received telemetry signal and the retrieved patient data. Specifically, the determination made at step **806** is used to define which expertise or specialty is required to render a diagnosis for the event. Additionally, having determined which expert specialty is required, the physician database **400** is accessed to determine which physicians associated with the appropriate specialty are available (per availability field **460**).

[0097] At step **908** a query is made as to whether the patient requires that a first available physician be contacted (a code R-FA in the patient criteria code field **630** of the patient's record in the patient database **600**). Certain alarm codes may also indicate to the system that a first available physician is to be contacted. A code R-FA indicates that a patient is either medically compromised to such an extent that immediate intervention or at least a diagnosis from a physician is required. Therefore, in view of the immediate need for such a diagnosis from an expert, it is imprudent to perform any sorting or preferential arranging of potential experts. Rather, it is most prudent to simply offer to all appropriate and available physicians the "job" of rendering a diagnosis for this event. If the query at step **908** is answered affirmatively, then the method **900** proceeds to step **909**. If the query at step **908** is answered negatively, then the method **900** proceeds to step **910**.

[0098] At step **909** an offer is sent to all appropriate and available physicians as determined during step **906**. That is, each physician or expert having the appropriate expertise to render a diagnosis for the present event is offered the chance to render such a diagnosis in exchange for compensation. The method **900** then proceeds to step **924** where it is exited (e.g., the method **800** resumes control at step **814**).

[0099] At step **910** the patient criteria codes are compared to the physician criteria codes of the appropriate and available experts or physicians. That is, at step **910** a comparison is made between the contents of the appropriate patient criteria code field **540** of the patient criteria table **500**B and the physician criterion code field **520** of the physician criteria table **500**A to determine if any of the physicians that are appropriate and available have conflicting criterion codes. For example, in the case of a patient criteria code indicative of a requirement for a male physician having a fee structure in the lower 33rd percentile, female physicians and those physicians having fee structures in the middle and upper 33rd percentile would conflict. At step **912** those

physicians having conflicting criterion are eliminated from consideration for an offer of compensation in exchange for diagnostic services. The method **900** then proceeds to optional step **914** or to step **916**.

[**0100**] At optional step **914** those physicians having criterion conflicting with the patient's insurance company are eliminated from consideration of receiving an offer of compensation in exchange for their diagnosis. That is, those physicians deemed by the patient's insurance company to be undesirable, too expensive, not included within the health plan or network, in competition with the patient's insurance company's preferred physicians or otherwise deemed unsuitable by the insurance company are eliminated from consideration of an offer (unless later needed, per step **918**).

[**0101**] In addition to the expert and patient criteria stored in patient criteria table **500**B and physician criteria table **500**A, respectively, the geographic location of the patient and the geographic are the physician is licensed to practice in may be taken into consideration by the system **100**. For example, only doctors that are licensed to practice in Virginia may be selected for a case of a patient located (or whose state of residence is) Virginia. The areas a physician is licensed to practice in may be stored in the physician criteria table **500**A or otherwise accessed by the system **100**. The patient's location may be determined via GPS locator **135** or the patient may be queried for his current location. If the patient's area of residence is a relevant factor, the residence may be stored, for example, in the patient criteria table **500**B. In other embodiments a physician that is not licensed to practice in the patient's are may be contacted by the system but may need to work with or through another physician that is licensed in the patient's area to render the diagnosis (e.g. local physician may need to approve diagnosis).

[**0102**] At step **916** those experts and/or physicians determined to be appropriate and available (per step **906**) and not eliminated from consideration due to conflicting criterion with a patient (step **912**) or insurance company (step **914**) criterion list are preferentially sorted per the patient's criteria. That is, those experts still remaining are sorted according to attributes deemed by a patient to be more favorable. For example, in the case of a patient criteria indicative of a preference for a male physician, and a preference for a board certified physician, physicians meeting these preferred criteria will be preferentially considered to physicians not meeting these criteria. Thus, the outcome of step **916** is a preferentially sorted list of physicians. Physicians near the top of the list are more preferable from the patient's perspective to those physicians near the bottom of the list. This does not mean that the physicians near the bottom of the list are unacceptable; rather that the physicians near the bottom of the list simply fail to meet or to confirm to the patient's criteria as well as those physicians near the top of the list. The method **900** then proceeds to step **918**.

[**0103**] At step **918** a query is made as to whether a minimum number of physicians or experts are remaining. That is, a query is made as to whether a predetermined minimum number of physicians are remaining within the pool or group of those physicians under consideration for an offer. The predetermined number may comprise one, three or any appropriate number. In the interest of ensuring that an expert diagnosis is rendered in a timely manner, it may be the case that the predetermined minimum number of physicians being sent an offer at any one time should be low, e.g., five. Thus, if the query at step **918** is answered negatively (e.g., only four physicians in the case of a five physician minimum avoiding elimination for consideration of an offer), then the method **900** proceeds to step **920**. If the query at step **918** is answered affirmatively, then the method **900** proceeds to step **922**.

[**0104**] At step **920** the criteria of acceptability is widened such that more physicians are included within the list of physicians being considered. For example, the criteria may be widened to include physicians of any gender, regardless of patient preference. The method **900** proceeds from step **920** to step **912**.

[**0105**] At step **922** an appropriate respective offer of compensation in exchange for a diagnosis for the particular event triggered by the telemetry signal received at step **804** is sent to each of the remaining physicians. The method **900** then proceeds to step **924** where it is exited (e.g., method **800** is re-entered at step **814**).

[**0106**] It should be noted that in the event of no experts indicating an acceptance of their respective offers, additional offers may be transmitted at the same or an enhanced compensation rate to the initial experts selected. Alternatively, some or all of the selected experts are replaced by alternate experts and a new round of offers is made.

[**0107**] **FIG. 10** depicts a flow diagram of an offer processing method suitable for use in the expert selection method of **FIGS. 9A and 9B**. Specifically, **FIG. 10** depicts a flow diagram of a method **1000** for processing offer requests or for sending offers to remaining physicians suitable for use in, e.g., step **922** of the expert selection method **900** of **FIGS. 9A and 9B**.

[**0108**] The offer processing method **1000** is initiated at step **1002** and proceeds to step **1004**, where a request to send an offer to one or more physicians is received.

[**0109**] At step **1006** a determination is made as to the appropriate compensation level to be associated with each of the one or more offers to be made to physicians or other experts. An appropriate compensation level may be determined with respect to, per box **1008**, historical data, current demand, insurance contracting, other contracts or other inducements.

[**0110**] Historical data comprises data indicative of past offers that have been accepted or rejected by a particular physician. The historical data may be further refined into acceptance and rejection data associated with particular offers on particular days of a month (e.g., weekends or week days) and other historical factors relating to the order acceptance/rejection history of a physician. The offers made field **770** and offers accepted field **780** of the event database **700** provides useful historical data that may be correlated to individual physicians or experts. After determining the appropriate offer levels, the method **1000** then proceeds to step **1010**.

[**0111**] Current demand comprises an indicator of an amount of demand for diagnostic services for a particular specialty. For example, during a heat wave compounded by an electrical failure in a city requiring air conditioning it may be the case that current demand for cardiologists and other

specialists engaged in the diagnosis and/or treatment of heat-related conditions may be quite high. In this case, such an expert may be extremely busy and more likely to reject an offer to render a diagnosis in the absence of a sufficiently large monetary inducement.

[0112] An insurance contract binding a particular physician to the treatment of a patient carrying that insurance at a set contract rate may be honored. Therefore an offer to such a physician may include the appropriate contract compensation rate. However, by pre-arrangement, a patient availing himself or herself of the system of the present invention may indicate that an additional inducement is to be offered (paid by the patient) to a physician beyond any contract rate negotiated by an insurance company. For example, a person of sufficient means, but insufficient cardiac strength, may offer an additional cash inducement to the hospital or other medical facility or health care provider such that an offer made to a physician should include the insurance contract rate plus the additional cash inducement offered by the patient to arrive at a "bump-up" offer price. Other contractual considerations may include secondary insurance or "gap" insurance in the case of senior citizens or others availing themselves of Medicare and/or Medicaid. In such situations where insurance company contract payments are relatively low, it behooves the patient to increase the level of compensation to some extent such that it is likely a physician will accept the offer of compensation and render the necessary diagnosis.

[0113] At step **1010** the respective offers determined at step **1006** are sent to the respective physicians or experts. The method **1000** then proceeds to step **1012**.

[0114] At step **1012** some or all of the telemetry data, medical records and patient preferences are sent to the physicians or experts receiving offers. The purpose of this data transfer is primarily to provide the expert with sufficient information to make a decision as to whether or not to take the case. However, if all of the patient data is sent, then it is possible that the physician may accept and render an opinion at substantially the same time. The method **1000** then proceeds to step **1013**.

[0115] At step **1013** the method **1000** waits for a predefined maximum period of time to receive one or more "accept" signals which are received from physicians or experts to whom offers have been sent. That is, a physician may have received an offer via his physician terminal device **110**, e.g., a personal digital assistant (PDA) or other portable communication device proximate to the physician. Upon reviewing the offer and, perhaps, some initial patient data, the physician may decide that time allows him or her to render a diagnosis to the patient. In such a situation the physician signals to the central server **200** his or her acceptance of the offer by sending a page or otherwise communicating with the central server **200**. For example, upon receiving an offer via a physician terminal device **110**, a physician may sit down at a computer terminal and access the server via, e.g., the internet, thereby directly accepting the offer. In the case of a physician accepting an offer via logon to the server using the internet, the dissemination of telemetry data, medical records and patient preferences indicated at step **1012** is performed by the physician downloading this information to his local computing device. Upon receiving at least one "accept" signal within the predefined maximum period of time, or the expiration of that time without receiving an accept signal, the method **1000** proceeds to step **1014**.

[0116] At step **1014** a query is made as to whether any "accept" signals have been received. If the query is answered affirmatively, then the method **1000** proceeds to step **1016**. If the query is answered negatively, then the method **1000** proceeds to step **1015**.

[0117] At step **1015** the offers are increased. For example, each offer may be increased by a fixed amount (e.g., $25), an amount determined as a percentage (e.g., 15%) of the existing offer or some other amount. It should be noted that an increased offer may be made to less than the entirety of physicians receiving an offer. For example, if one physician is known to typically accept offers above a certain amount, that physician may be provided with a second higher offer, while other physicians may receive second offers having unchanged (or minutely changed) offer amounts. The method **1000** then proceeds to step **1010**.

[0118] At step **1016** a query is made as to whether the patient associated with the present event is also associated with a code R-FA (requires first available physician). If the query at step **1016** is answered affirmatively, then the method **1000** proceeds to step **1018**. If the query at step **1016** is answered negatively, then the method **1000** proceeds to step **1020**.

[0119] At step **1018**, since the patient requires a first available physician, the first acceptance of a physician is confirmed. That is, regardless of patient preferences beyond those already used to screen the physicians to whom offers were made, the first physician indicating his or her acceptance of an offer is confirmed by the central server **200**. Confirmation of an offer by the central server **200** entails indicating, in some manner, to the physician that the physicians diagnosis is required, that compensation per the offer will be made for that diagnosis, and that the physician should now be rendering that diagnosis.

[0120] At step **1020**, since the patient does not require the first available physician, at least one acceptance is confirmed based upon the preferential sorting of the physicians to whom offers were made. That is, in the case of a patient having an insurance company that will pay for the services of one physician to render a diagnosis for an event, the one accepting physician meeting all or most of the patient's preferences will be confirmed as the physician or expert involved in the event. It should be noted that in the case of the patient requiring two or more expert diagnosis to be rendered, the two or more physicians most closely conforming to the patient's preferences as indicated by the patient criterion database **500**B will be confirmed.

[0121] At step **1022** a confirmation signal is sent to the one or more physicians or experts to be confirmed. The confirmation signal may be sent via the physician terminal device **110** (e.g., pager, cellular or terrestrial telephone link, computer network, satellite network or any other communications medium).

[0122] At step **1024** the necessary medical history, current condition and other data associated with the patient and the present event is transmitted to the physician terminal device **110**. It should be noted that this step comprises, essentially, the same functionality described above with respect to step

814 of the method **800** of **FIGS. 8A and 8B**. As such, step **814** may be skipped if the method **1000** of **FIG. 10** is being called as, e.g., a sub-method of the method **800** of **FIGS. 8A and 8B**. The method **1000** then proceeds to step **1026** where it is exited (e.g., the expert selection routine **900** of **FIGS. 9A and 9B** is reentered at step **924**).

[**0123**] **FIG. 11** depicts a flow diagram of a patient care diagnosis delivery method **1100** suitable for use in the patient care diagnosis delivery system **100** of **FIG. 1**. In the embodiment of **FIG. 11**, the telemetry unit associated with a patient includes at least rudimentary diagnostic capability such that the alarm signal transmitted by the telemetry device includes a particular diagnosis that is associated with an element of the alert field **310** of the reaction database **300** of **FIG. 3**. For example, in the case of a patient telemetry device **120** determining that the patient is suffering ventricular fibrillation, an alert message indicating ventricular fibrillation is transmitted as an alarm signal to the central server **200**.

[**0124**] The patient care diagnosis delivery method **1100** is initiated at step **1102** and proceeds to step **1104**, where an alarm signal is received from a patient telemetry device. The method **1100** then proceeds to step **1106**.

[**0125**] At step **1106** a determination is made as to the appropriate reaction to the alarm signal using the reaction database **300**. This determination includes determining an appropriate type of position or expert and whether an ambulance is required. For example, in the case of a received alarm signal indicative of ventricular fibrillation, an appropriate system reaction (per system reaction field **320** of reaction database **300**) comprises summoning an ambulance to pick up the patient and bring the patient to a nearby medical treatment facility and offering the case to physicians or experts comprising cardiologists or heart specialists.

[**0126**] At step **1108** a query is made as to whether an ambulance is required. If the query at step **1108** is answered affirmatively, then the method **1100** proceeds to step **1110** where an ambulance is summoned. The method then proceeds to step **1112**. If the query at step **1108** indicates that an ambulance is not required, then the method **1100** proceeds directly to step **1112**.

[**0127**] At step **1112** at least one expert is alerted to the event associated with the received alarm, the patient's medical history, a description of the patient's current state and an offer of compensation is then made to the at least one expert in exchange for taking the case (i.e., rendering a diagnosis).

[**0128**] At step **1114** an "accept" or "decline" signal is received from the at least one expert or physician alerted at step **1112**. The method **1100** then proceeds to step **1116**. At step **1116** at least one of the physicians from the pool or group of physicians or experts indicating an acceptance of the case is selected. The method **1100** then proceeds to step **1118**.

[**0129**] At step **1118** a confirmation signal is sent to the accepting expert or experts. At this point the accepting and confirmed physician or expert has taken the case and is expected to render an expert diagnosis using the data transmitted at step **1112** in exchange for the compensation offered at step **1112**. The method **1100** then proceeds to step **1120** where it is exited.

[**0130**] An example of an application of the invention will now be described with respect to a cardiac patient. Specifically, it is assumed that the cardiac patient is at a medical facility or at home and that a patient telemetry device monitors the patient physiological parameters including heart activity via, e.g., an electrocardiogram (ECG) function. The ECG continuously monitors the patient's heart and the resulting data is sent to the central server **200** as part of a compressed data stream transmitted via a patient telemetry device **120**.

[**0131**] The central server **200** receives the data and analyzes the data to detect any aberrant data patterns, i.e., data patterns indicative of a cardiac anomaly. When such a pattern is detected, the computer compares it with predefined malignant patterns (i.e., data profiles) to ascertain whether or not the pattern requires intervention on the part of the patient or the hospital. If the pattern of the received data describes a malignant aberrance such as heart palpitations or arrhythmia, a signal is sent to the patient (to apprise him or her of the situation), and one or more cardiologists are selected to receive an offer according to both patient and physician criteria, as previously described. If a more serious condition were detected, such as a cardiac arrest, the system would summon an ambulance to the patient's location—which could be determined with a GPS unit in the patient telemetry device **120** and also contact a cardiologist. If the pattern observed by the system did not match either a benign or pathological pattern, the system would notify the patient and provide a phone number to call for further assessment of the situation.

[**0132**] The physician terminal device **110** in the example comprises a Personal Digital Assistant (PDA) that is used in conjunction with wireless data transfer. A plurality of experts meeting the appropriate criteria are paged and provided with the patient's current condition, medical records and respective monetary offers. An expert who accepts the case indicates that acceptance via the PDA, which provides two-way paging capability. Depending on the case, the expert communicates with the central server **200** via the PDA, a mobile phone, a computer or some combination thereof. When the expert completed the services required, he or she would indicate this by way of the PDA and a financial account associated with the expert is credited with the amount offered.

[**0133**] If an expert takes too long in responding, the system might make a second or third offer. However, since a large financial risk is associated with the expert attempting to "game" the system (i.e., wait for a, presumably, higher second or third offer), it is likely that the expert will respond quickly if the expert can practicably handle the case. It is noted that, in effect, the plurality of experts receiving offers are in competition with each other. The first (and possibly second) expert accepting the offer will likely exclude from contention the expert trying to elicit a larger second offer.

[**0134**] Advantageously, the invention provides a system that will alert physicians and/or patients when the patient's health takes a turn for the worse. Whether or not a patient lives through a cardiac arrest is often determined by how soon he receives treatment. By cutting the medical response time to the absolute minimum, the inventive system will save lives and reduce impairments to those lives.

[**0135**] In another embodiment of the invention, the expert utilizes the internet to retrieve patient information and

render a diagnosis. When contacted with an offer, the expert goes to a web site, types in his expert ID, the patient's ID (received with the offer) and is immediately provided with the patient's records and current condition.

[0136] In another embodiment of the invention, the central server **200** sends case offers to hospitals, which then act as clearinghouses for the doctors employed there. For example, the server receives an alarm signal from a monitored patient and sends the offer to one or more hospitals, which then have the option of taking the case, depending on how busy they are. Essentially, the invention operates as a "traffic controller" for hospitals. In this embodiment, a medical facility is associated with at least one expert and comprises infrastructure suitable for remediating physiological dysfunction. The system procures a diagnosis from experts via the facility by transmitting offer(s) to the facility for subsequent communication to the appropriate experts. The facility may adapt the offer (e.g., increase the amount) to ensure that an ambulance delivers a patient to the facility where the physician has admitting rights. The adaptation of the offer may be performed in response to a level of facility utilization and a level of physiological dysfunction urgency associated with said offer. That is, in response to a level of facility utilization being above a threshold level and a level of physiological dysfunction urgency being below a threshold level, the offer may be adapted to cause the patient to be delivered to an alternate or affiliated medical facility for processing.

[0137] A plurality of medical facilities may be operably linked together by a central server via a communications system such that the central server, in response to an offer received from a system controller, determines which one of the plurality of medical facilities should receive the offer and communicates the offer to the determined medical facility. Additionally, the determination of the central server may be made using at least one of the following criteria applied to said medical facilities: proximity to a patient, general facility utilization level, appropriate department utilization level (e.g., intensive care unit, trauma unit, emergency room and the like), a level of expertise in treating an indicated physiological dysfunction, possession of equipment suitable for treating the indicated physiological dysfunction, membership in a predetermined health care provider group and participation in a predetermined insurance plan.

[0138] In another embodiment of the invention, the invention allows at least voice communication between the remote physician and the patient. The physician gives instructions to the patient on how best to act until an ambulance arrives. If the patient is unconscious, the physician may interact with a bystander to remotely help the patient. Additionally, the physician may optionally administer drugs remotely if a patient telemetry device **110** is equipped with a drug dispensing unit **135**.

[0139] In one embodiment of a compensation scheme of the present invention, the expert may enter into an agreement with the system wherein the expert is paid a previously established compensation amount on a periodic basis in exchange for agreeing to accept a predetermined minimum number of cases during each compensation period. For example, a physician may agree to accept ten cases per week in exchange for receiving $1000 on a bi-weekly basis. In such an agreement there may be a further provision that the expert will receive an additional compensation for accepting more than the minimum number of cases required under the agreement. In such an embodiment an expert may still be selected and offered a case on a real-time basis (i.e. as a case is recognized by the system) since the expert may not be available at a time when a patient is in need the system may contact such an expert and await an accpetance in a method similar to those described above. However, unlike in some of the previously described embodiments, in this embodiment the offer to the expert would not necessarily include a compensation amount. Although the offer could include a reminder of the periodic compensation amount, the portion of the periodic compensation amount that this case may be worth to the expert, or how many cases the expert still has to accept within the current period in order to earn the periodic compensation amount.

[0140] **FIG. 13** depicts table **1300**, an exemplary illustration of a compensation agreement database **800**, which could be used by system **100** to track compensation agreements with experts in the embodiment where an expert is compensated by a predetermined amount on a periodic bases. Table **1300** comprises exemplary records **1301** through **1301**. Each record contains data stored in an agreement identifier field **1310**, a physician identifier field **1320**, a compensation amount field **1330**, a compensation periodicity field **1340**, a minimum case per period field **1350**, a bonus case amount field **1360**, and a current cases taken field **1370**.

[0141] The agreement identifier field **1310** stores an identifier that uniquely identifies an agreement between an expert and system **100**. The physician identifier field **1320** stores an identifier that uniquely identifies a physician participating in the system **100** who corresponds to each respective agreement identifier. The compensation amount field **1330** stores the compensation amount corresponding to each respective agreement identifier, which the corresponding physician will receive in exchange for accepting cases through the system **100**. Although monetary compensation amounts are illustrated in the figure, the compensation amount could comprise other forms of compensation. For example, in exchange for participating in the system **100** an expert could receive (i) a reduction in insurance premiums; (ii) points or credits in a club or professional association; (iii) alternate currency such as frequent flier miles; (iv) continued access to a service, establishment, or product; or (v) public recognition for donating time to pro bono work. Such alternate forms of compensation, of course, may be implemented in all embodiments of the present invention.

[0142] Returning now to table **1300**, the compensation periodicity field **1340** stores the time period corresponding to each agreement identifier during which the expert must accept cases in order to qualify for the compensation amount. The minimum cases per period field **1350** stores the minimum number of cases corresponding to each agreement identifier which an expert has agreed to accept in order to qualify for the compensation amount. Typically each case that an expert accepts will count as a single case. However, it is contemplated that an expert may receive credit towards the minimum number of cases requirement equaling more than one case for accepting certain cases. For example, if a case is particularly complicated or the resolution of which takes an inordinately long amount of time, the expert may receive a multiple case credit for accepting that case. Similarly, if the system **100** is experiencing difficulty in obtaining

an acceptance from experts for a particular case, the system **100** may transmit an offer to an expert communicating that if the expert accepts this particular case it will count as two or more cases towards meeting his minimum number of cases requirement under the agreement. Although the term "cases" has been used it should be understood that a case may comprise a single event requiring a diagnosis or multiple events associated with the same patient and the same condition that may require the expert to communicate with the system and/or patient in more than one instance.

[**0143**] Returning again to table **1300**, the bonus case amount field **1360** stores a bonus compensation amount that corresponds to each agreement identifier. A bonus compensation amount is an amount of compensation that an expert is to receive for each case that he accepts over the minimum number of cases required under his agreement. Thus, for example, Record **R1301** illustrates that if physician "123456" accepts seven cases in a given week he will receive a total compensation amount of $600 for that week ($500 compensation amount for six required cases+$100 bonus amount for one non-required case). Of course rather than receiving extra compensation for accepting cases beyond the minimum number of cases the expert may be rewarded in other ways. For example, Record **1302** of table **1300** illustrates that physician "789012" will receive credit towards the minimum number of cases for the next period for any case he accepts beyond the minimum number of required cases in a current period.

[**0144**] The current cases taken field **1370** stores the updated amount of cases that have been accepted to date for a given period by a physician corresponding to an agreement identifier. This field may be used by the system **100**, for example, to determine whether to (i) contact a physician with a current case; (ii) remind a physician regarding how many more cases he is still required to accept for the current period; or (iii) to provide the physician with compensation for the current period and, if so, what the compensation amount should be. For example, a physician may not agree to have any offers for cases transmitted to him once he has accepted the minimum number of cases so if the number of cases accepted is equal to the minimum number of cases for a given agreement, the system may remove the physician from the pool of possible physicians to contact for a given case. Similarly, the system **100** may take into consideration whether a particular physician has met his minimum number of cases requirement and would thus require a bonus compensation amount for accepting the current case (and, perhaps, what that bonus compensation amount is) before selecting that physician to contact for a current case.

[**0145**] If an expert does not meet his minimum number of cases for a given period he may be penalized in a variety of methods. For example, the physician may have (i) his compensation amount for the period reduced, (ii) his entire compensation for the period forfeited, or (iii) the number of cases under the minimum number of cases for the current period added as additional required cases to a subsequent period.

[**0146**] In another embodiment of the present invention the experts may not be contacted by the system with offers for available cases. Instead, the experts may contact the system and view available offers when the experts are available to provided diagnoses. Of course, such an embodiment may be combined with an embodiment where the experts are contacted by the system. For example, the system may select and contact experts as described above each time a patient is determined to be in need of help. However, while the system is awaiting responses from the contacted experts the case will be made available for consideration and acceptance by other experts (e.g. on a website of the system).

[**0147**] Although various embodiments which incorporate the teachings of the present invention have been shown and described in detail herein, those skilled in the art can readily devise many other varied embodiments that still incorporate these teachings.

What is claimed is:

1. A method comprising:

receiving from a remote monitoring device an indication of a physiological anomaly associated with a patient;

selecting at least one remote expert from a plurality of potential remote experts to provide an opinion regarding the anomaly;

determining at least one compensation amount to be provided to at the least one of the at least one selected remote experts in exchange for the opinion; and

causing a communication with the at least one selected remote expert to be initiated, wherein the communication comprises a request for the opinion in exchange for the compensation amount.

2. The method of claim 1, wherein the remote monitoring device is a portable device.

3. The method of claim 1, wherein the step of selecting comprises:

selecting, based on the received indication, at least one remote expert from a plurality of remote experts to provide an opinion regarding the anomaly.

4. The method of claim 1, further comprising:

receiving the opinion from the at least one selected remote expert after the step of causing the communication; and

providing a diagnosis to the patient based on the opinion.

5. The method of claim 1, wherein the step of selecting comprises:

determining at least one of at least one patient preference and at least one patient parameter associated with the patient;

determining at least one expert criterion associated with each of the plurality of potential experts; and

selecting at least one expert from the plurality of experts based on a comparison of:

the at least one of the at least one patient preference and the at least one patient parameter to:

the at least one expert criterion.

6. The method of claim 1, wherein the step of selecting comprises:

determining an area of medicine associated with the anomaly; and

selecting at least one expert from the plurality of potential experts that practices in the area of medicine.

7. The method of claim 1, wherein the step of determining at least one compensation amount comprises:

selecting at least one compensation amount based on a minimum compensation amount previously agreed to by the at least one expert.

8. The method of claim 1, wherein the step of determining at least one compensation amount comprises:

determining at least one compensation amount based on at least one of

(i) a current time of day;

(ii) information associated with the patient;

(iii) information associated with the at least one expert;

(iv) an area of medicine associated with the anomaly;

(v) an area of medicine associated with the at least one expert;

(vi) at least one compensation amount previously offered to at least one expert from the plurality of potential experts;

(vii) at least one compensation amount previously accepted by at least one expert from the plurality of potential experts;

(viii) whether the expert has previously provided an opinion regarding the patient; and

(ix) a number of experts selected.

9. The method of claim 1, further comprising:

determining that none of the selected experts has responded affirmatively to the transmitted request;

determining an increased compensation amount for at least one of the selected experts; and

causing a communication to be initiated with the at least one expert wherein an indication of the increased compensation amount is transmitted.

10. The method of claim 1, further comprising:

receiving a response indicating a willingness to provide an opinion in exchange for the compensation amount from at least one of the selected experts; and

causing data indicating the anomaly to be provided to the at least one expert who responded.

11. The method of claim 10 wherein the step of causing data indicating the anomaly to be provided comprises:

transmitting data indicative of the anomaly to the at least one expert who responded.

12. The method of claim 10 wherein the step of causing data indicating the anomaly to be provided comprises:

providing, to the at least one expert who responded, access to the data indicating the anomaly via at least one of an internet and an intranet site.

13. The method of claim 10 further comprising:

causing to be provided, to the at least one expert who responded, additional information associated with the patient.

14. The method of claim 13 wherein the additional information comprises the patient's medical history.

15. The method of claim 1, wherein the expert is at least one of a physician, a nurse, and a medical technician.

16. The method of claim 1, wherein the communication includes an indication of the compensation amount.

17. The method of claim 1, further comprising:

establishing a direct communication link between the at least one selected expert and the patient.

18. A method comprising:

receiving, from a remote monitoring device, an indication that a patient is in need of a medical diagnosis;

selecting a plurality of remote experts to provide the diagnosis;

transmitting physiological data associated with the patient to the plurality of remote experts;

receiving at least one opinion from the plurality of experts; and

determining an aggregate diagnosis based on the at least one opinion.

19. The method of claim 18, further comprising:

determining a compensation amount to be provided to each of the plurality of experts; and

causing the compensation amount to be provided to each of the plurality of experts in exchange for the at least one opinion.

20. The method of claim 19, wherein the step of determining a compensation amount is determined before the step of transmitting and further comprising:

transmitting to each of the plurality of experts an indication of the compensation amount as part of a request to provide an opinion; and

receiving a response to the request from each of the plurality of experts.

21. The method of claim 20 further comprising:

determining the number of responses that are an acceptance of the offer.

22. The method of claim 21 further comprising:

transmitting the request to additional experts if the number of responses that are an acceptance is below a minimum number.

23. The method of claim 22 further comprising:

determining at least one increased compensation amount; and

transmitting a request for the opinion in exchange for the increased compensation amount to at least one of the experts whose response was not an acceptance if the number of responses that are an acceptance is below a minimum number.

24. The method of claim 18, further comprising:

determining a first compensation amount for a first expert that is included in the plurality of experts; and

determining a second compensation amount for a second expert that is included in the plurality of experts.

25. The method of claim 24 wherein the first compensation amount is not the second compensation amount.

26. The method of claim 18, wherein the step of determining an aggregate diagnosis comprises:

receiving an opinion from each one of the plurality of experts;

categorizing each of the opinions into a possible diagnosis; and

selecting, as the aggregate diagnosis, the possible diagnosis that the most opinions are categorized into.

27. The method of claim 18, wherein at least one of the plurality of experts is in a location different from the location of at least another of the plurality of experts.

28. The method of claim 18 wherein each of the plurality of experts provides an individual opinion regarding the patient.

29. The method of claim 28 wherein at least one of the plurality of experts is unaware that another of the plurality of experts is also providing an opinion regarding the patient.

30. The method of claim 18 wherein the plurality of experts communicate with one another before providing an opinion regarding the patient.

31. The method of claim 30 wherein the plurality of experts, after communicating with one another, provide a single opinion regarding the patient.

32. The method of claim 31 wherein the step of determining an aggregate diagnosis comprises:

utilizing the single opinion is used as the aggregate diagnosis.

33. The method of claim 18, further comprising:

transmitting the aggregate diagnosis to the patient.

34. A method, comprising:

establishing an agreement with an expert, wherein the agreement specifies a periodic compensation amount that the expert will receive in exchange for providing a minimum number of diagnoses during a time period;

transmitting, during the time period, a plurality of requests to the expert, wherein each request comprises a request for a diagnosis of a physiological anomaly associated with a patient;

receiving, from the expert, a response to each of the requests;

receiving, for each response that is an acceptance of the request, the diagnosis for the patient of the request; and

causing the compensation amount to be provided to the expert if, at the end of the time period, it is determined that the expert has provided the minimum amount of diagnoses during the time period.

35. The method of claim 34, further comprising:

selecting the exert from a plurality of remote experts based on a received anomaly and the agreement.

36. The method of claim 34, further comprising:

causing a reduced compensation amount to be provided to the expert if, at the end of the time period, it is determined that the expert has not provided the minimum amount of diagnoses during the time period.

37. The method of claim 34, further comprising:

causing the compensation amount to be withheld from the expert if, at the end of the time period, it is determined that the expert has not provided the minimum amount of diagnoses during the time period.

38. The method of claim 34, further comprising:

incrementing a stored number of diagnoses provided by the expert during the time period when the diagnosis is received.

39. The method of claim 38, further comprising:

determining that the diagnosis provided is associated with at least one factor that indicates a complication in providing the diagnosis; and

incrementing the stored amount of diagnoses by an additional amount based on the at least one factor.

40. The method of claim 39, wherein the at least one factor that indicates a complication in providing the diagnosis comprises at least one of:

(i) a greater than average complexity in the anomaly,

(ii) a greater than average amount of time required to provide the diagnosis,

(iii) an indication that the expert communicated directly with the patient, and

(iv) an indication that the patient's life was saved due to the diagnosis.

41. The method of claim 40, further comprising:

providing to the expert, at least once during the time period, an indication of a current number of diagnoses provided.

42. A method, comprising:

establishing an agreement with an entity, wherein the entity agrees to continuously monitor physiological parameters through at least one telemetry device in exchange for compensation;

wearing the at least one telemetry device;

receiving an indication from the entity that an anomaly has occurred in at least one of the physiological parameters; and

receiving a diagnosis based on the anomaly.

43. The method of claim 41, wherein the step of receiving a diagnosis comprises:

receiving a diagnosis based on the anomaly, wherein the diagnosis includes at least one instruction regarding an action to be taken in accordance with the diagnosis.

44. The method of claim 42, wherein the action to be taken comprises:

an action to be taken by the entity.

45. The method of claim 42, wherein the at least one instruction comprises:

an instruction to take a medication.

46. An apparatus comprising:

a storage device; and

a processor connected to the storage device,

the storage device storing a program for controlling the processor; and

the processor operative with the program to:

receive from a remote monitoring device an indication of a physiological anomaly associated with a patient;

select at least one remote expert from a plurality of potential remote experts to provide an opinion regarding the anomaly;

determine at least one compensation amount to be provided to at the least one of the at least one selected remote experts in exchange for the opinion; and

cause a communication with the at least one selected remote expert to be initiated, wherein the communication comprises a request for the opinion in exchange for the compensation amount.

47. A computer readable medium encoded with processing instructions for implementing a method, the method comprising the steps of:

receiving from a remote monitoring device an indication of a physiological anomaly associated with a patient;

selecting at least one remote expert from a plurality of potential remote experts to provide an opinion regarding the anomaly;

determining at least one compensation amount to be provided to at the least one of the at least one selected remote experts in exchange for the opinion; and

causing a communication with the at least one selected remote expert to be initiated, wherein the communication comprises a request for the opinion in exchange for the compensation amount.

48. An apparatus comprising:

a storage device; and

a processor connected to the storage device,

the storage device storing a program for controlling the processor; and

the processor operative with the program to:

receive, from a remote monitoring device, an indication that a patient is in need of a medical diagnosis;

select a plurality of remote experts to provide the diagnosis;

transmit physiological data associated with the patient to the plurality of remote experts;

receive at least one opinion from the plurality of experts; and

determine an aggregate diagnosis based on the at least one opinion.

49. A computer readable medium encoded with processing instructions for implementing a method, the method comprising the steps of:

receiving, from a remote monitoring device, an indication that a patient is in need of a medical diagnosis;

selecting a plurality of remote experts to provide the diagnosis;

transmitting physiological data associated with the patient to the plurality of remote experts;

receiving at least one opinion from the plurality of experts; and

determining an aggregate diagnosis based on the at least one opinion.

50. An apparatus comprising:

a storage device; and

a processor connected to the storage device,

the storage device storing a program for controlling the processor; and

the processor operative with the program to:

establish an agreement with an expert, wherein the agreement specifies a periodic compensation amount that the expert will receive in exchange for providing a minimum number of diagnoses during a time period;

transmit, during the time period, a plurality of requests to the expert, wherein each request comprises a request for a diagnosis of a physiological anomaly associated with a patient;

receive, from the expert, a response to each of the requests;

receive, for each response that is an acceptance of the request, the diagnosis for the patient of the request; and

cause the compensation amount to be provided to the expert if, at the end of the time period, it is determined that the expert has provided the minimum amount of diagnoses during the time period.

51. A computer readable medium encoded with processing instructions for implementing a method, the method comprising the steps of::

establishing an agreement with an expert, wherein the agreement specifies a periodic compensation amount that the expert will receive in exchange for providing a minimum number of diagnoses during a time period;

transmitting, during the time period, a plurality of requests to the expert, wherein each request comprises a request for a diagnosis of a physiological anomaly associated with a patient;

receiving, from the expert, a response to each of the requests;

receiving, for each response that is an acceptance of the request, the diagnosis for the patient of the request; and

causing the compensation amount to be provided to the expert if, at the end of the time period, it is determined that the expert has provided the minimum amount of diagnoses during the time period.

* * * * *

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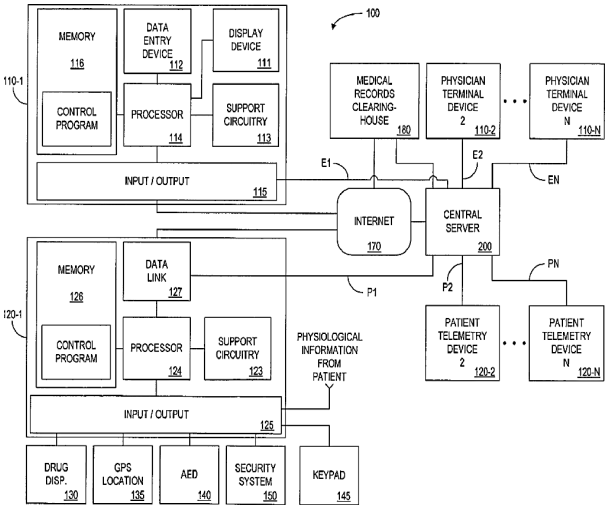
摘要(译)

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